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ABSTRACT

This resource guide is designed for use by teachers. Units are included on the energy crisis, environmental awareness, and decision making concerning shrinking energy resources. Both short-term and long-term problems and alternatives are discussed. Group and individual activities are suggested. Charts and graphs, suitable for making transparencies, are included. A bibliographic section describes books, films, and government publications that are pertinent to the topics. (LS)

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CREATE TOMORROW . . . TODAY

AN ENERGY AWARENESS PROGRAM

of the

WASHINGTON STATE

SUPERINTENDENT OF PUBLIC INSTRUCTION

March 1974

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To be consistent with the spirit of conservation, we ask that teachers share this resource. Sufficient copies have been printed to make one book available for every two classroom teachers.

SPI **Superintendent of Public Instruction**
DR. FRANK B. BROUILLET · OLD CAPITOL BLDG., OLYMPIA, WASH. 98504

February 1974

TO THOSE CONCERNED WITH ENERGY AWARENESS EDUCATION:

This document--Create Tomorrow Today--is part of a statewide effort to provide for our youngsters a sound educational base for the decisions they must make about their use of rapidly shrinking energy resources.

While it is true that all of us must make adjustments in our present life styles because of the energy crisis, our primary responsibility is to prepare our children for the more severe changes that are part of their future.

In this book are guidelines and instructional tools that are offered for use by teachers and administrators in our schools. Many of these activities provide ways for immediate changes in our use of energy, but of even greater importance is the philosophy that motivates this and other efforts to deal with the energy crisis on a long-range basis.

We must help our students adapt to ways of living that consume less energy than we now use, and we must help them learn how to explore for new sources of energy, for other ways of using present supplies, and for different ways of relating energy to our environment.

Frank B. Brouillet

Frank B. Brouillet

CONSIDER THE PROCESS OF LIVING

Although we may study the structure of the vocal chords and may learn how a flute is made, there is nothing in such knowledge by which to understand their music.

And although we may study the origins of air and water, soil and energy and know their parts, there is little in that knowledge by which to understand the process of living.

For the process of living is not unlike a concert of great music--a concert in which the notes from single instruments are joined with those of others in harmony and time to form an infinite variety of melodies and themes--much as air and water, soil and energy are the instruments which enable plants to grow, fish to feed, and artists to create new symphonies.

Every form of life is thus a single theme--moving to a rhythm of its own, but moving also in relation to the other themes--separate yet interwoven, together forming a fabric which is more diverse and richer than any of its single threads--the whole and all its parts dependent on the instruments which give them being. Such is the process of living . . .

(Reprinted, by permission of
The Conservation Foundation, from
"Consider the Process of Living.")

CREATE TOMORROW . . . TODAY

Our goals are twofold:

To initiate a level of awareness in people consistent with man's growing understanding of energy.

To develop a personal commitment by individuals to voluntarily reduce energy consumption.

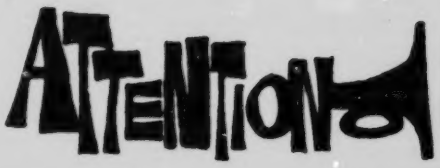
The activities in this document were designed to be somewhat ambiguous in order for you to have as much flexibility as possible to be creative. All the activities cannot be accomplished in one week, so pick a few with which you'll have success. Modify and use the suggested activities with the available information in a way that will fit your style and needs. Involvement should be the name of the game, and in each case we hope the learners can interact with as many resources as possible.

PICK A FEW ACTIVITIES

You aren't expected to do them all, but it is hoped that you will find a way to integrate some of these activities with your classroom program. It is suggested that each individual identify two or three of these activities that they would like to work on (as individuals or groups) during Energy Awareness Week. It is expected that the results of individual efforts will be shared with the rest of the class or the school. Some of the activities may take more than five days, so you'll need to take that into consideration when making choices.

These materials are intended to enhance and enrich classroom activities, and surface a greater awareness of the energy problems that face the individuals of our society. Enough facts and/or activities cannot be provided in a one week period of time to significantly change individual life styles but a greater awareness of the dimensions of energy problems facing individuals will be realized. Set the stage for a long-term educational effort, and provide the initial excitement and enthusiasm necessary to affect a significant energy conservation ethic in the school population.

With these points in mind, plan and conduct a school wide energy awareness program. Include posters, speakers, activities, media of all kinds, contests and things that could potentially involve families and the community.



Warning to the Reader:

Any time students go into the community to survey or interview adults, the survey instrument should be developed in advance by the student or the class and approved by the teacher and/or the building administrator.

FEED BACK

Please be sure to complete the feedback/evaluation sheet on the last page of this book. We need to know about the results of your efforts. Turn the completed page in to your principal, so that all copies from your building can be sent in together.

Your critical commentary will be appreciated. We'll count on you to let us know what happened in your school.

Finally, Bob Samples, Director of the ESSENTIA Project at The Evergreen State College, commented recently on the response of the individual relative to our energy problem:

> "The problem is not rational . . . it's intuitive. I've got to feel the need for solution, not the preachy, speechy tactics of the logical rationale of let-me-tell-you-the-facts approach. I've got to feel personally guilty or personally competent as I decide where I drive off to or stay away from. I don't turn lights out because I am supposed to but because I want to."

Think about that.

Help us

Create tomorrow . . .

Today.

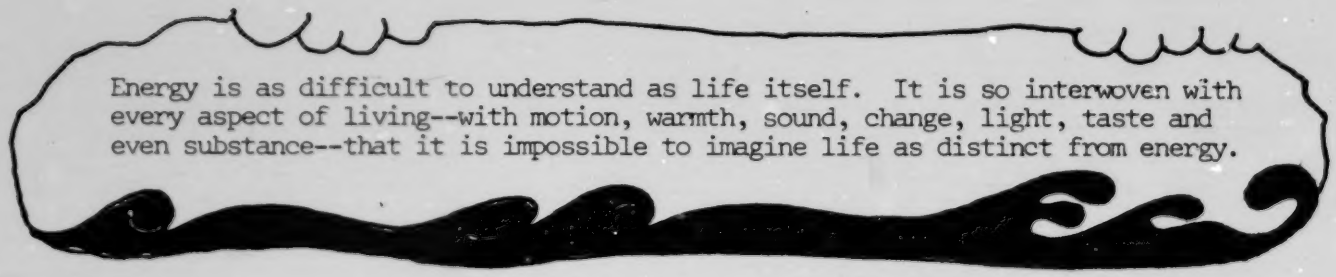
ENERGY RELATED ACTIVITIES

These activities focus on energy related learning opportunities for teachers and students. The activities and information provided are designed to help create an awareness of energy problems. Since our goal is awareness, this program has not been designed with a great deal of structure. If structure is needed, we hope you'll add it.

The teachers of Project U.S.E., an ESEA Title III Program involving Seattle and Bellevue, created the following goals and learning categories when they developed an energy education program. Perhaps these can be of some assistance:

PROJECT U.S.E. GOALS AND CATEGORIES

- The concept of energy, its characteristics and properties.
- The major sources of energy, and understanding that these sources are limited.
- The major uses of energy and analysis of limitations required for man's survival on earth.
- The relationship between man's uses of energy and his personal value system.
- The relationship between man's wants and man's needs, and the energy requirements associated with satisfying these wants and needs.
- The present status of energy sources and the need for alternative strategies for energy use.


Energy is as difficult to understand as life itself. It is so interwoven with every aspect of living--with motion, warmth, sound, change, light, taste and even substance--that it is impossible to imagine life as distinct from energy.

CURRICULUM OVERVIEW

(PRIMARY IDEAS)

I. THE NATURE OF ENERGY	II. MAN'S PAST SOURCES AND USES OF ENERGY	III. MAN'S PRESENT SOURCES AND USES OF ENERGY	IV. MAN'S FUTURE SOURCES AND USES OF ENERGY
The sun is the primary source of energy. 1	Man is dependent on energy. 5	Modern man requires a high energy life style. 9	Man's survival is contingent on future energy resources. 13
Energy can change from one form to another. 2	Man has an irreducible energy need to sustain a minimum type of existence. 6	Pollution is one result of an inefficient high energy system. 10	Man must develop alternative energy resources. 14
Energy is the ability to do work. 3	Man's energy needs were met from renewable resources. 7	Modern man's life styles are inconsistent with energy conservation and management practices. 11	Limited energy resources will necessitate a change in man's future life styles. 15
All living things depend on energy. 4	Man's energy needs were met without major changes in the natural environment. 8	Man's energy resources are limited. 12	Man must develop a sense of concern about the future of unborn generations. 16
This column attempts to answer the following question: What is it?	This column attempts to answer the following questions: What have been the sources? How has man used them?	This column attempts to answer the following questions: What are our present sources? How are we using them today? What impact on the environment?	This column attempts to answer the following questions: What are our future sources? How should we use them? How do we preserve the future?

INDIVIDUAL OPTIONAL ACTIVITIES

1. Draw a map of your house. Put an "X" at the place where a light switch is in each room. Put an "O" at each place where there is an outlet. For one week, check electric lights and appliances at least three times a day for wasted energy. How many did you find in one week? Make a guess how long each appliance was on beyond the time it was actually needed.

2. Make a list of all the things in your house that use electricity. Make a class list.

3. Walk around your neighborhood and discover as many energy wasters as possible. Make a class list. What can you do about it?

4. Bring an energy picture to class. Write a poem about it.

5. Find out how far it is from your home to school. Try to figure out how far it is for each of the following: shortest, longest, quickest and safest.

6. Draw or make a model of the flow of oil from ground to refinery. Where does it go next?

7. Make a list of plastic packaging at home and in a grocery store. What is plastic made of? Are there better resources for packaging?

8. Find some water in your environment that does not seem to be related to your life, then prove any way you can that it is!

9. Figure out all the ways water affected your life yesterday. Do you see a pattern?

10. Write a commercial about water as an energy source.

11. Research how oil is manufactured by nature. When did man start using oil from the ground? How many barrels each day? Today? Predictions on how long it will last. Then what?

12. Learn something new about the energy crises. Make a poster and share with classroom of younger children. Ask them to tell you what it says.

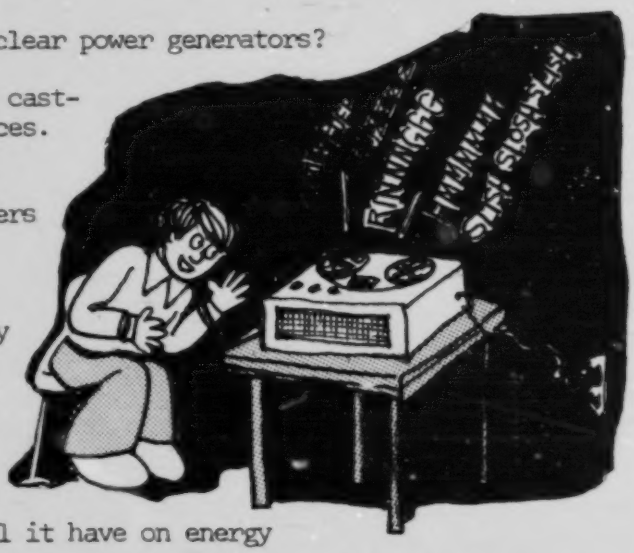
13. Find information on the electric automobile. Why is it being developed? What are the problems?

14. Gather information about nuclear power generators?

15. Make a junk sculpture using cast-off or expended energy sources.

16. Tape record some sounds of energy being used. Can others identify them?

17. Go outside and find joy in your environment. Is energy involved in any of these? List them. Share your list with a friend.



18. Plan a transportation system for your city for the year 2000. What effect will it have on energy use?

19. Write or tape an imaginary interview with an historical figure from the past about comparing energy uses today with his time.

20. List all the "energy users" that you personally own or use, such as radios, toys, appliances, etc. In the list, state the type of energy required, such as AC power battery, wind-up spring, etc. After completing the list, compare it with the items a student might own in a nation which uses less energy, such as India. Try to list the "energy users" the Indian child might use.

21. Identify ways of extending the life of the crude oil supply. Basically, this is done by reducing consumption. Take it from there!

22. The student will go to the kitchen of a school or home and itemize the utensils or equipment that aid in the changing of one form of energy to another. Can you design a utensil that will do the same work as one you saw at school but which is not as wasteful of energy?

23. Assume that a definite amount of energy will be allotted to meet all your physical and psychological needs. Assume that amount of energy is about half of that which you presently consume. How would you modify your life style to conform to the energy available?

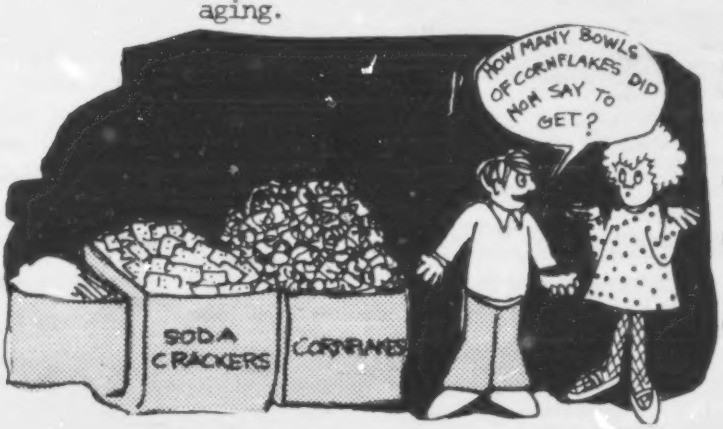
24. Assume the amount of all energy resources available to this country were cut in half. The student will list the ways in which life in this local community would be affected.

25. The student will design 12 lapel buttons with slogans that will inform people about the need to reduce the use of energy.

26. Assume that all oil deposits in the U.S. became exhausted by the year 2025. List the jobs that would be eliminated as a result. Discuss what that means in terms of vocational planning for your children.

27. The student will research the life styles of the Australian aborigines, the Eskimos and the Kalahari Desert tribes. What are their energy resources? What might that mean for us if we are faced with severely restricted energy resources? How would the student modify his life style? Justify the choices.

28. If it is true that some packaging is non-essential, and is thereby a wasteful use of natural resources (raw material and energy), what specific jobs would be affected by the elimination of excessive packaging.



(a) List jobs affected.
(b) Determine whether an increase or decrease in the cost of the item would result.
(c) What problems of shipping and storage would result?
(d) Itemize sanitary implications for ten grocery or drugstore items that are edible.
(e) Explore other economic implications.

29. Identify the occupations that would be affected and the sources of energy that would be made more available if the principal mode of transportation in a city were to change from private automobile to mass transit (buses, trains).

30. The student will construct a chart showing the transition of vegetation from plants to coal.

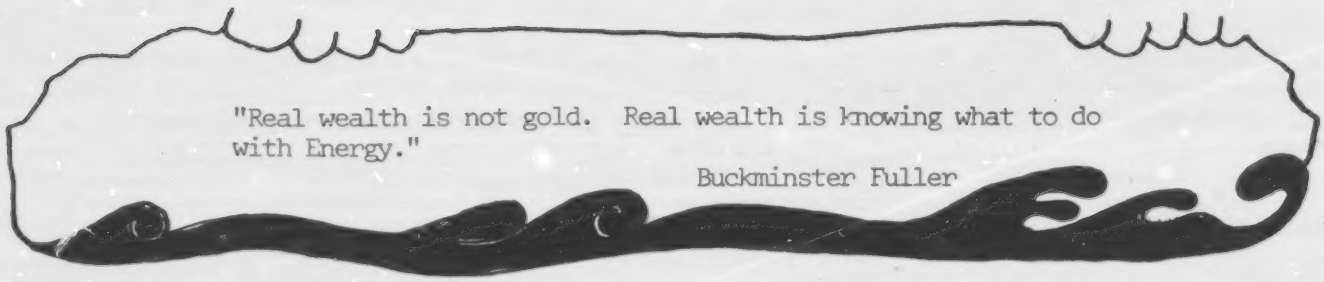
    plant material: peat--lignite--bituminous coal--anthracite coal

    Time, heat and pressure

    Describe how man uses each of the items in the chart.

31. The student will construct a model that constitutes "the good life" which can be used as background for making judgments concerning energy-resource use, considering both himself and others.

32. Make up an optional activity of your own.



"Real wealth is not gold. Real wealth is knowing what to do with Energy."

Buckminster Fuller

CLASS & SMALL GROUP ACTIVITIES

1. Make a mini oil slick in a pan of water. FIX IT! How many other ways can you develop to fix it?

2. What things can you personally relate to that would be useless without electricity? What would life be like without electricity?

3. Plan strategy to keep an ice cube from melting in the classroom for as long as possible. What does it mean? How many other ways work?

4. How cool can we make the schoolroom and be reasonably comfortable? Identify individual tolerances.

5. Each student bring in 5 unique pictures showing some energy use. Divide into teams and make a collage using all pictures. Classify the pictures into categories you determine, and make a statement explaining your classification system.

6. In groups, identify some of the sources of heat used by people around the world. Why do they use those sources?

7. Individually, identify some misuses of energy at school and at home. Compile a list of common misuses; develop a plan to make a difference.

8. Choose any plastic container. In small groups, brainstorm a list of as many different uses as possible that might be made of it. Who has the most? Identify most creative ideas. How does plastic relate to an energy source? Where does plastic come from?

9. Keep a record of the garbage your family throws out over a seven-day period. Weigh or measure the dimensions of the garbage and divide the total for the week by the number in the family. Multiply this average by the number of people living in your community. List on the board those items you can recall that were potential sources of energy.

10. As a class project, build a fully functioning windmill and show the variety of uses the source of energy can provide and determine its limitations.

11. The students will describe desirable limitations of individual energy use. How does individual use of energy affect others? If we stopped using energy, how would that affect others?

12. Which fuels contribute more undesirable pollutants than others? Which fuels are most desirable to use?

    Assume a perfect fuel would:

    ____ be unlimited in supply
    ____ be equally distributed throughout the world
    ____ present no technological problems
    ____ be highly efficient
    ____ present no aesthetic problems
    ____ have no adverse impact on the environment

    The student will select the fuel he feels is the most nearly perfect fuel and defend this choice. Debate and/or discuss the pros and cons of the many fuels selected by class members.

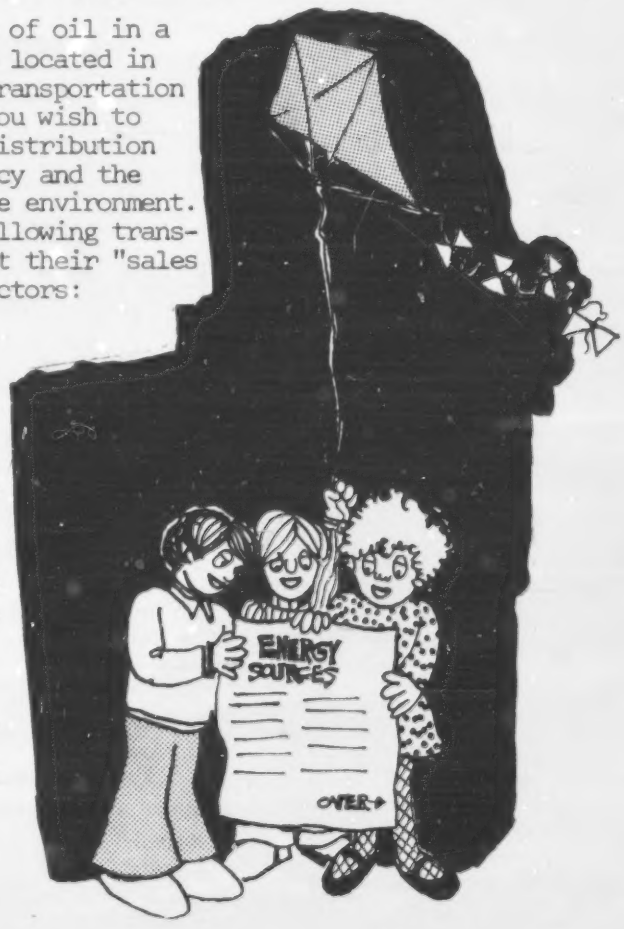
13. The student will research and prepare presentations for each of the roles presented below:

    You are a large distributor of oil in a metropolitan area. You are located in an area accessible to the transportation facilities listed below. You wish to transport the oil to your distribution plant with maximum efficiency and the least adverse effects on the environment. Representatives from the following transportation facilities present their "sales pitch" to you and your directors:

    (a) railroads
    (b) trucks
    (c) freighters
    (d) pipelines

    Which means will you choose and why?

    The students will, on a world map, locate important sources of energy fuels and major energy users.



14. Make a list of energy sources that are used without being changed to help you, such as:

    (a) floating logs down a stream
    (b) flying a kite
    (c) sailboats

    How important are these kinds of energy sources in our lives?

15. The students will read their home watt-hour meter and school watt-hour meter daily for one week (month?). Discuss the comparative energy consumption. Graph the results. Refer to p. 34 to learn how to read a meter.

16. To conserve gasoline, pretend that a decision has been made to reduce the amount of gasoline available for automobiles in this country. What priorities and regulations would be needed to accomplish this as fairly as possible for all citizens?

17. Under what conditions is it fair for the United States to use 25 times as much of an unrenewable resource as another smaller underdeveloped country?

    The students will assume the roles of representatives of the United Nations. Argue before that body for a fairer share of the world's resources.

18. The students will participate in a spelling bee that uses words about energy: potential--kinetic--heat--light, etc. How many of these energy words can you define?

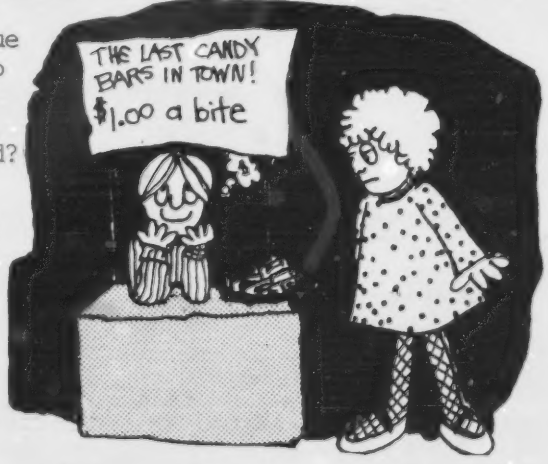
19. List energy-conversion products (heat, gas, water, light, electricity, torque, noise, work, etc.). The student will choose one, then play a role in which he assumes the identity of that product. Get together with another "product" unlike himself and decide how he would like to be treated as society disposes of him.

    Present conclusions to the class.

20. What considerations should be made when members of your family purchase major electric appliances? Ask what influences their selection of brand, size and model? Ask whether the amount of electricity required is considered?

21. Make a list of their personal belongings acquired during the past two years which use energy. List those things they would like to acquire. What's a list like this good for? Do you see any trends in your purchases?

22. The local stores have all announced that due to a transportation strike there will be no more candy bars for an extended period of time. What will happen to the present supply? How will the supply be distributed? Will there be restrictions as to how many bars each person will be permitted to buy? What will happen to the price? What will happen to you emotionally if there are no restrictions and someone ahead of you buys the last box of bars? What will you be willing to do to get some of those bars? Now, relate this scenario to an energy-related problem.



23. The students will compare the sources of energy available to people living in the continental U.S., and compare the uses of energy by people living in:

    (a) Hawaii
    (b) Australia
    (c) Japan
    (d) Egypt
    (e) India
    (f) Alaska

24. Three elements of the "good life" are:

    (a) desirability of work and school environments
    (b) desirability of home environment
    (c) desirability of recreational environment

    With these in mind, please respond to the next 3 tasks:

    (1) List all energy-consuming devices needed for each environment and for transportation to each environment.

    (2) Describe the location in terms of the most desirable climate, landscape and population.

    (3) If a model city were to be built, locate it on a map. Could energy be transferred there, reasonably, from present sources?

25. The student will describe ways to minimize bad effects of obtaining energy resources:

    (a) coal (mines, strip mining)
    (b) oil (derricks, pipelines, offshore)
    (c) gas (pipelines, pumping stations)
    (d) wood (clear-cutting, transporting)
    (e) electricity (considered as a fuel)
    (f) nuclear fuels (mining)

    The student will describe the aesthetic effects of mining, refining, producing and/or delivering:

    (a) coal
    (b) oil
    (c) gas
    (d) wood
    (e) hydroelectric energy
    (f) nuclear-generated electric energy

26. From the following items, the student will list the energy consumed by each in its production and in its use. If the student had to cut his energy consumption drastically, which of these could he replace easily? Which would be more difficult? Which would be impossible?

Electric lighting	Prefab house
Electric cooking	Aluminum siding
Electric heat	Power lawn mower
Water heating	Steam shovel
Air conditioning	Electric toothbrush
Mixer	Power saw
Washer	Plastic modular furniture
Dryer	Dishwasher
Synthetic fiber clothing	Television
Wood frame house	Radio
Automobile	Stereo system
Stop lights	Road graders
Street lights	Tractors

27. TABLE I

U.S. Air Pollutant Emmissions, 1965

Source of Air Pollution	Millions of Tons	Percent of Total
Automobile	86	60%
Industry	23	17%
Electric Power Plant	20	14%
Space Heating	8	6%
Refuse Disposal	5	3%
Total	142	100%

Source: "The Sources of Air Pollution and Their Control," U.S. Public Health Service Publication, No. 1548, Washington, D.C.: U.S. Government Printing Office, 1966.

Using Table 1 as a source of data, the student will respond to the following questions:

(a) Which source is the single greatest contributor to air pollution?

(b) How does air pollution of all autos compare to the total of air pollutants contributed by industry, cluster power plants, space heating and refuse disposal?

(c) If a railroad "coal" car could hold a load of about 50 tons, how many railroad cars full of pollutants were put into the air in 1965?

Fun math question: If a railroad car were 50 feet long, how long a train would be necessary to carry all the air pollutants?

28. In order to help children understand the concept of a "trade-off", ask them to plan an imaginary trip to Disneyland using the following information:

In groups of 4 or 5, the students will pretend they are going to Disneyland. Select their method of transportation, what they will eat, and what they will do at Disneyland. Plan the trip with a total of $120 to spend.

How to get to Disneyland?

	Time	Cost	
Car	16 hours	$ 9.80	)
Train	10 hours	17.25	) one way
Plane	3 hours	31.75	)

What to do at Disneyland?

All exhibits and rides cost $1.50 each. (List what type of energy is used for each.) A book of 20 tickets costs $22.50.

Food? How will it be prepared and served? Where to eat? What waste will be involved?

Motel while at Disneyland--$12 per day. (Is there an alternative?)

The students must get to Disneyland and back home in three days. What will their choices be? Will they have to make any "trade-offs?" Will they spend all their money?

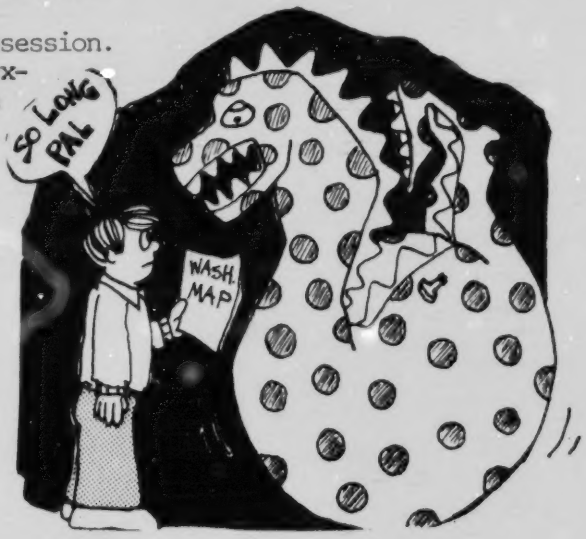
29. Pretend that four groups of people are going to set up housekeeping beside a common stream; their land is next to each other. They will generate their own energy. Group 1 will set up a coal-fired generating plant. Group 2 will set up a gas-fired generating plant. Group 3 will set up a nuclear-fired generating plant. Group 4 will set up a hydro-powered generating plant. Join one of these groups. Each group may oppose the erection of any other group's plant on the basis of pollutants, passage of fuel across their territory, use/abuse of a common resource such as air or water.

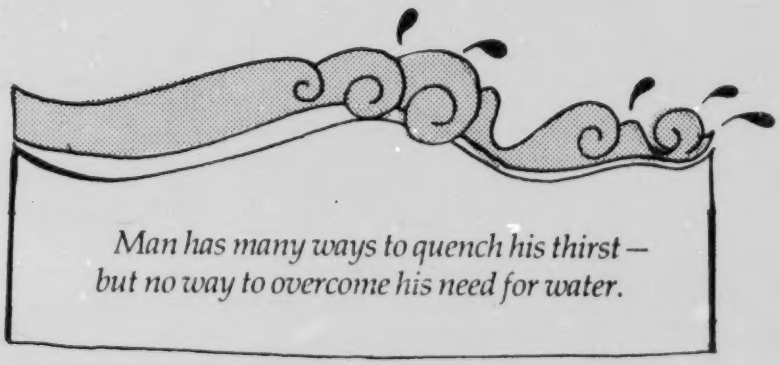
Defend the plant of one group, but eventually you decide the best possible method of generating electricity; whether it should be a common source or several generators and which one. If a common source is selected, whose land will it occupy and how much will be paid for the land use?

30. Students will pretend they are going on a camping trip 200 miles from home. The length of the vacation is two weeks. They wish to spend as little money as possible, spend as much time in the wilderness as possible and contribute as little pollution as they can. Based on these requirements, select a mode of travel, cooking fuel, housing en route, housing at the campsite, types of activities during the period at camp.

31. The student will pick one favorite possession which is made of man-made material (plastic or synthetic fiber). Also, select a short motor trip he would like very much to take.

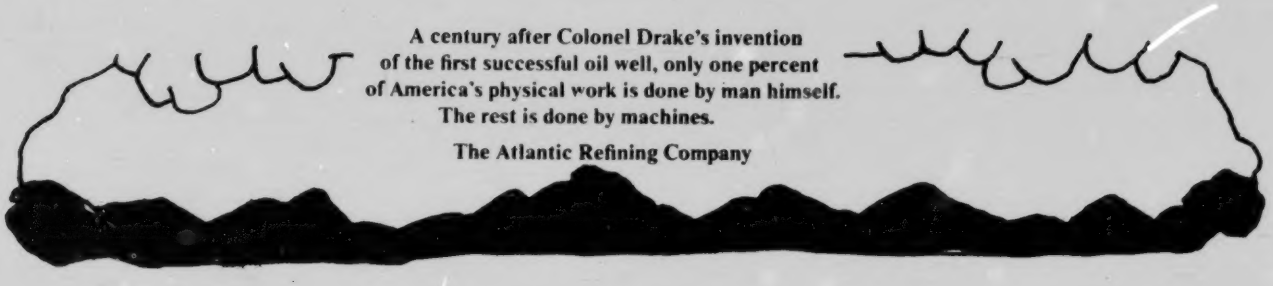
Decide between the trip and the possession. Defend the choice on the basis of expenditure of fossil resources. The trip would take energy and fossil fuel, and so did manufacture of the possession.





32. The students will go on a "field walk" with a small group of other students and list all the energy conversion they see. Do it in this manner:

Object Viewed	Energy Source	Ultimate Product
Automobile	Gasoline	Motion
Light Bulb	Electricity	Light
Sailboat	Wind	Motion


A century after Colonel Drake's invention
of the first successful oil well, only one percent
of America's physical work is done by man himself.
The rest is done by machines.
The Atlantic Refining Company

A WORD TO THE . . .

Essential to the compatibility of the natural world and our technologically advanced society is the constructive use of energy. This energy is produced by the consumption of natural resources, primarily the fossil fuels - coal, oil and natural gas. Conversion of raw fuels into electric energy has made possible the development of new industries, has made production processes more efficient, and has enabled the United States to achieve the highest standard of living in the history of mankind. With less than 5% of the world's population, the United States produces and consumes approximately 35% of the world's electricity--almost as much as the next five countries combined--Russia, Japan, the United Kingdom, Western Germany, and Canada. We have developed daily-living habits that have presumed inexhaustible resources and have led to the unwise use of energy. Waste has become a by-product of affluence.

It is now obvious that the United States is facing energy problems precipitated by a combination of factors:

(1) Personal affluence resulting in increasing demands for electrical energy
(2) A lack of major conservation efforts
(3) Federal budget cuts and "short-sighted" policies
(4) Delays by energy producers
(5) International relations and trade policies

With an expanding population and rising expectations and standards of living for an increasing number of people, we are confronted with ever-increasing demands for energy. Any failure to meet these demands will result in serious social and economic penalties. While a total lack of energy is not realistically forecast for the United States, there is a very real potential for an inadequate supply.

To avert widespread shortages and insure adequate energy supplies now and in the future, we must take positive corrective action to curtail unwise energy use. This does not mean that we must sacrifice the technological advances nor the standard of living we have achieved, but rather that we develop an "energy ethic." This "energy ethic" suggests that it is essential for all Americans to understand the economically and environmentally wise use of resources. Only then can we thoughtfully fulfill our responsibilities as citizens and realize in good conscience the innumerable benefits offered to us by energy.

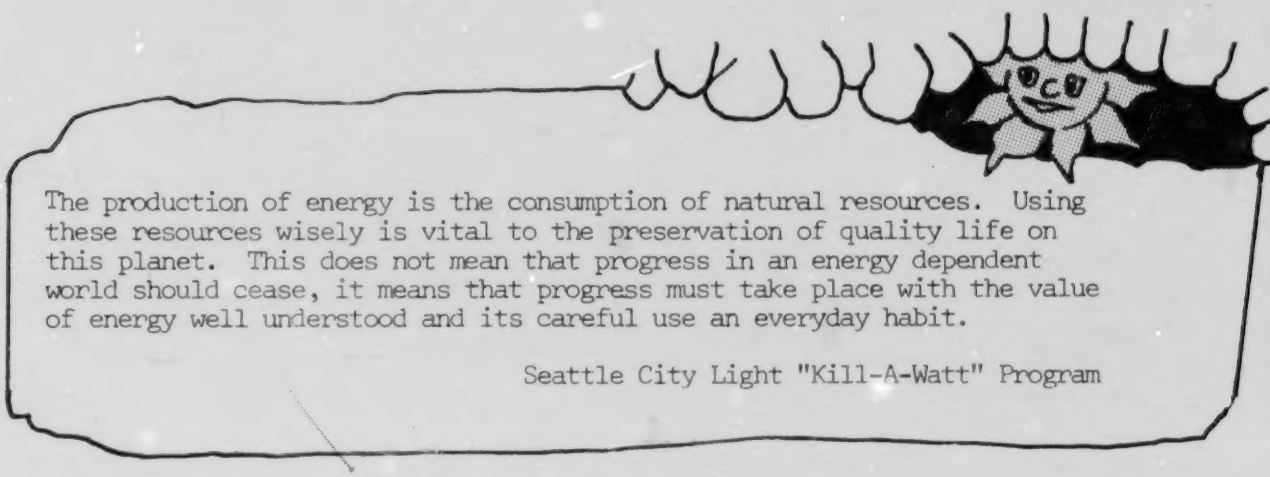
ENERGY USE IN PERSPECTIVE

Energy consumption in the world and in our nation has been growing steadily for several decades. The growth in the Pacific Northwest has followed general national trends as far as rate is concerned, although there are certain distinctive regional features such as heavy use of relatively cheap hydroelectric power.

Total consumption of energy in the Pacific Northwest was estimated to be 1,622 trillion BTU during 1971, which is the last year for which fairly complete data are available. Energy use is measured in British Thermal Units (defined as the amount of energy required to heat one pound of water one degree Fahrenheit) because the BTU is a convenient common basis for aggregating and comparing energy from different sources. For example, the 1,622 trillion BTU of energy used in the Pacific Northwest in 1971 consisted of approximately the following:

Electricity	117 billion kilowatt hours	= 398 trillion BTU
Natural Gas	313 billion cubic feet	= 324 trillion BTU
Petroleum products	142 million barrels crude equivalent	= 849 trillion BTU
Coal	760 thousand tons	= 19 trillion BTU
Uranium		= 32 trillion BTU

Some perspective on Northwest energy consumption may be gained by noting that the total energy used amounted to 252 million BTU per resident of the region, an overall rate of use that is slightly below that of several other regions within the United States. However, a better understanding of the current energy situation calls for a more complete accounting for the important patterns of energy consumption and supply within the region, as well as a perspective on national and worldwide energy resources.

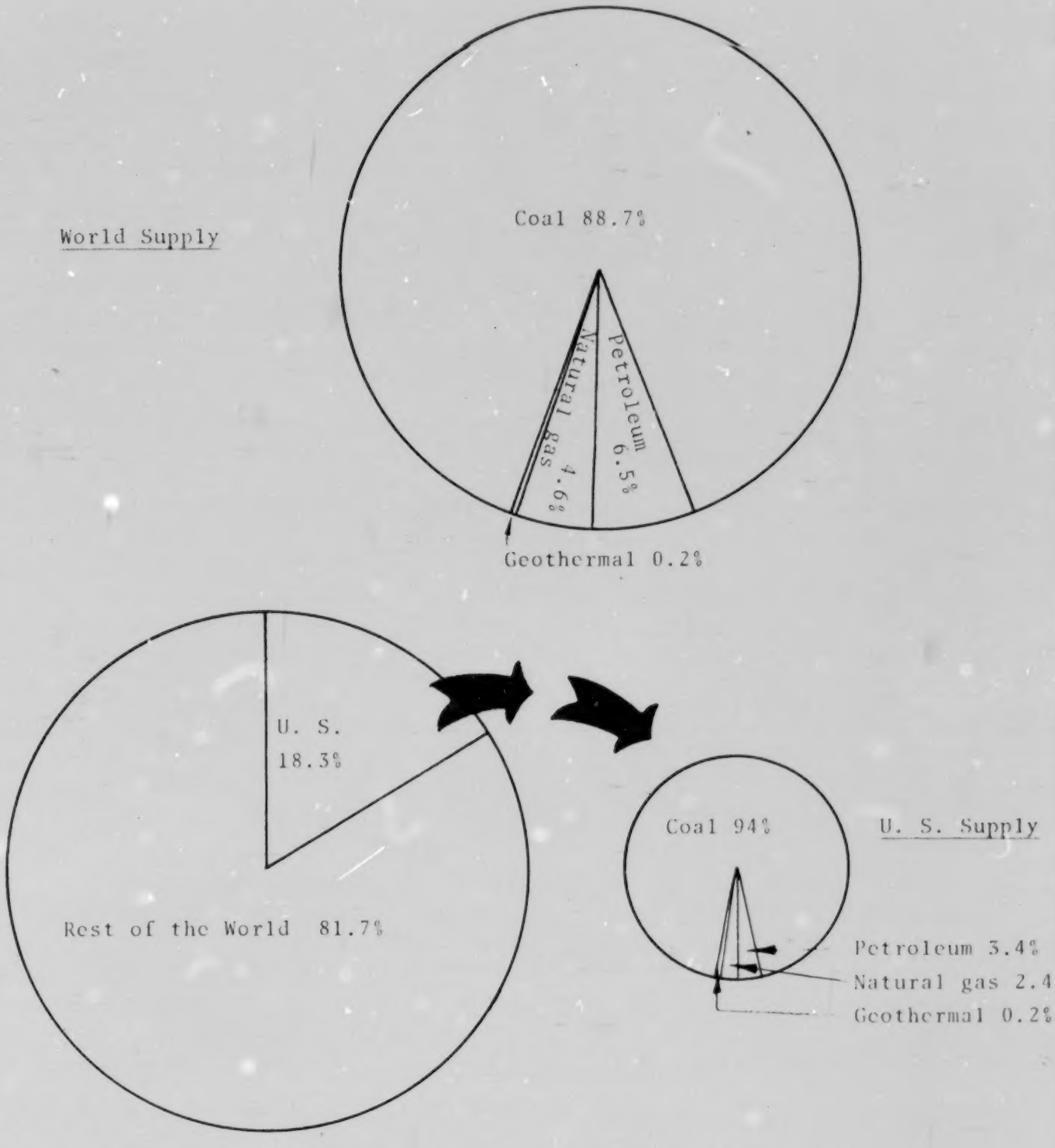


The production of energy is the consumption of natural resources. Using these resources wisely is vital to the preservation of quality life on this planet. This does not mean that progress in an energy dependent world should cease, it means that progress must take place with the value of energy well understood and its careful use an everyday habit.

Seattle City Light "Kill-A-Watt" Program

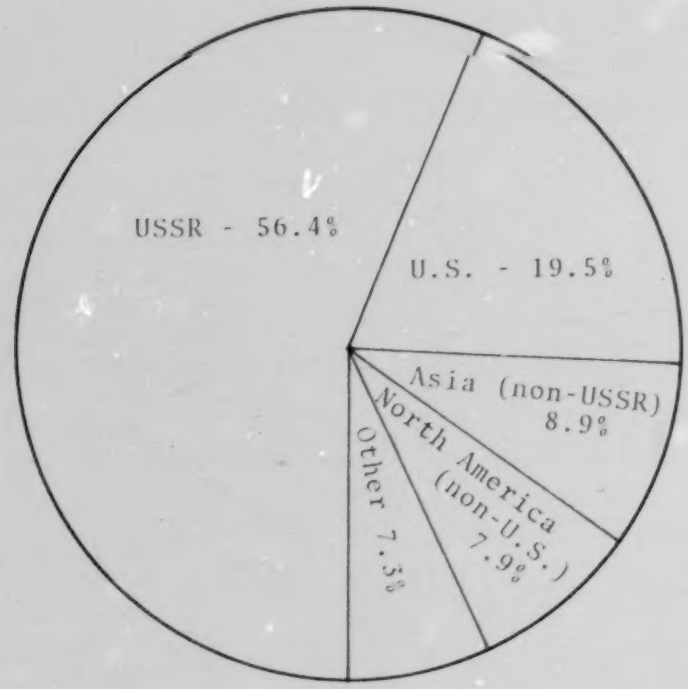
ENERGY-ENVIRONMENT FACTS

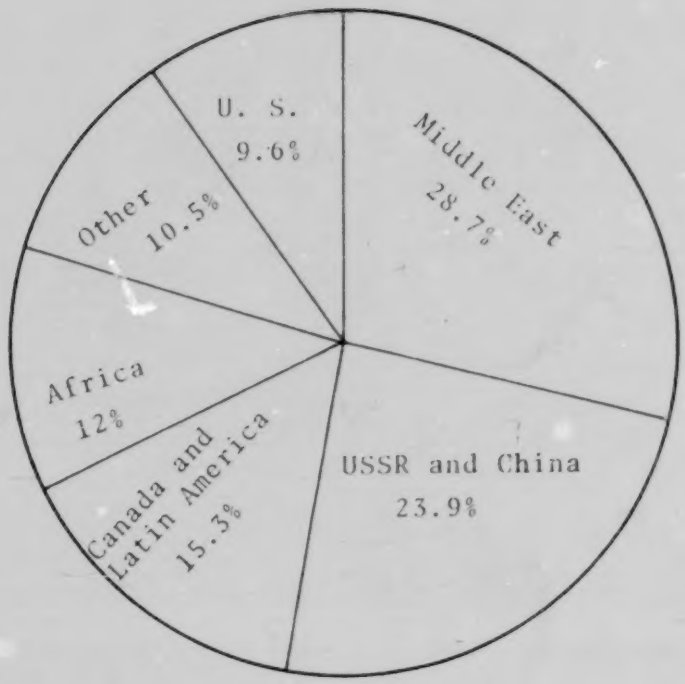
What Are the Forms of Our Non-Nuclear Energy Supply?



WORLD DISTRIBUTION OF COAL AND PETROLEUM

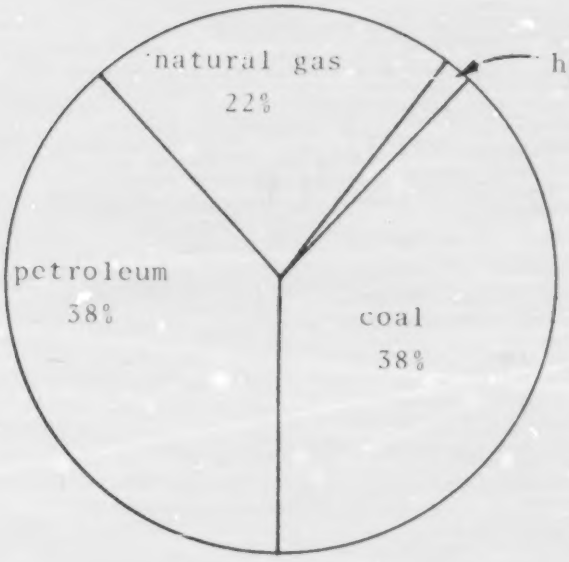
COAL



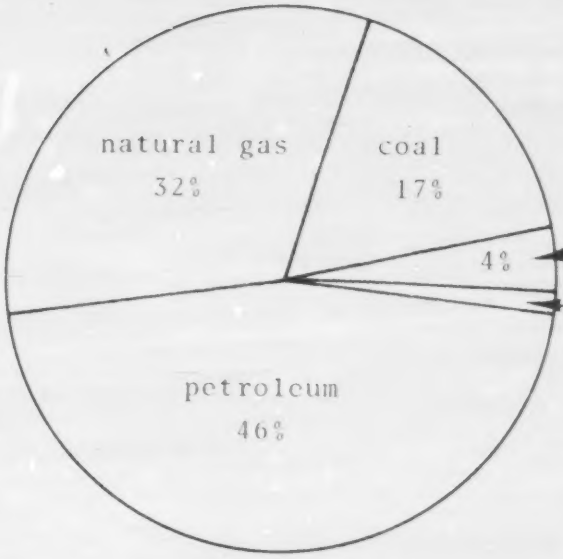


PETROLEUM

WHERE DO WE GET OUR ENERGY?

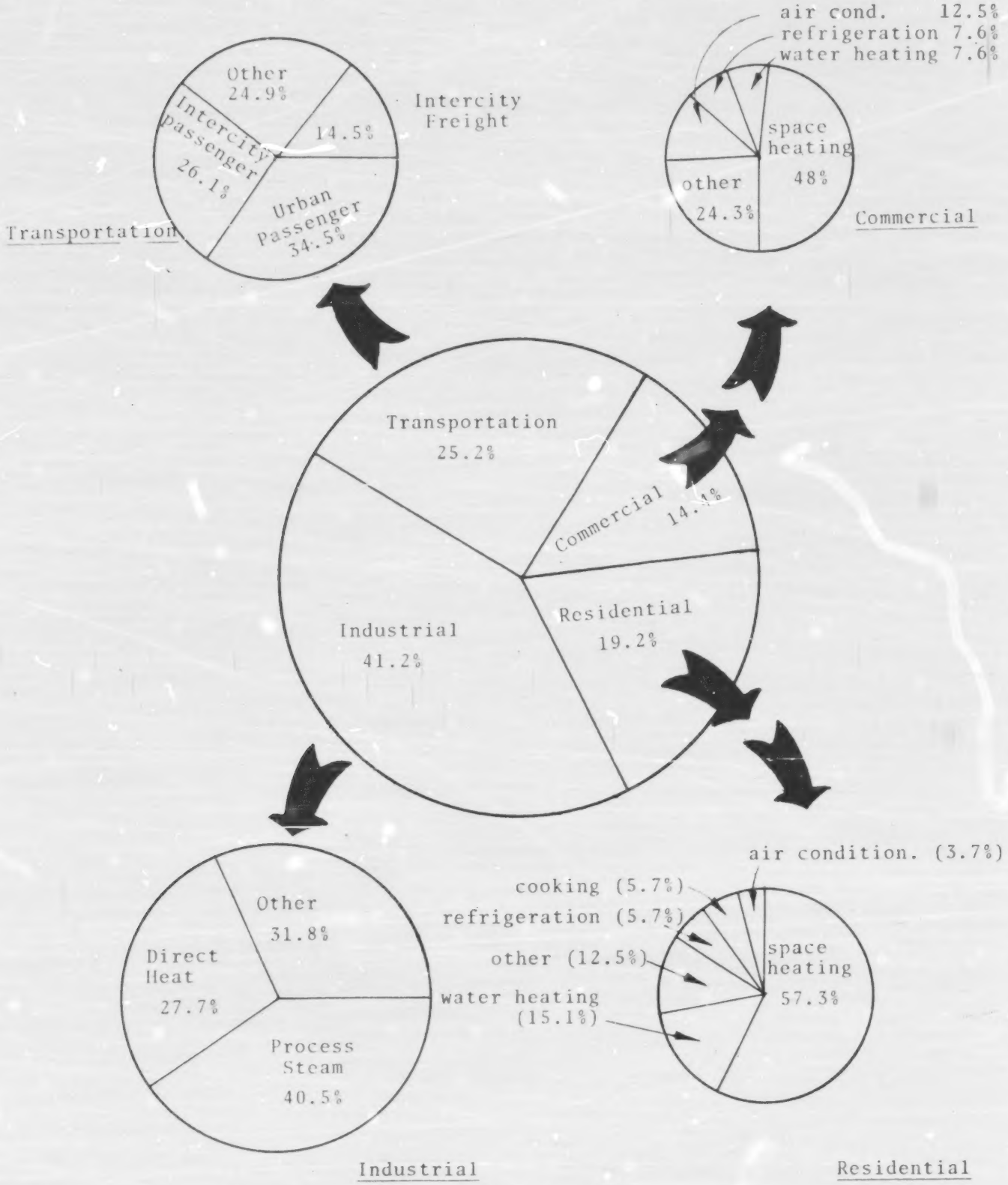


WORLD (1968)



U. S. (1972)

HOW DOES THE U. S. USE ITS ENERGY?

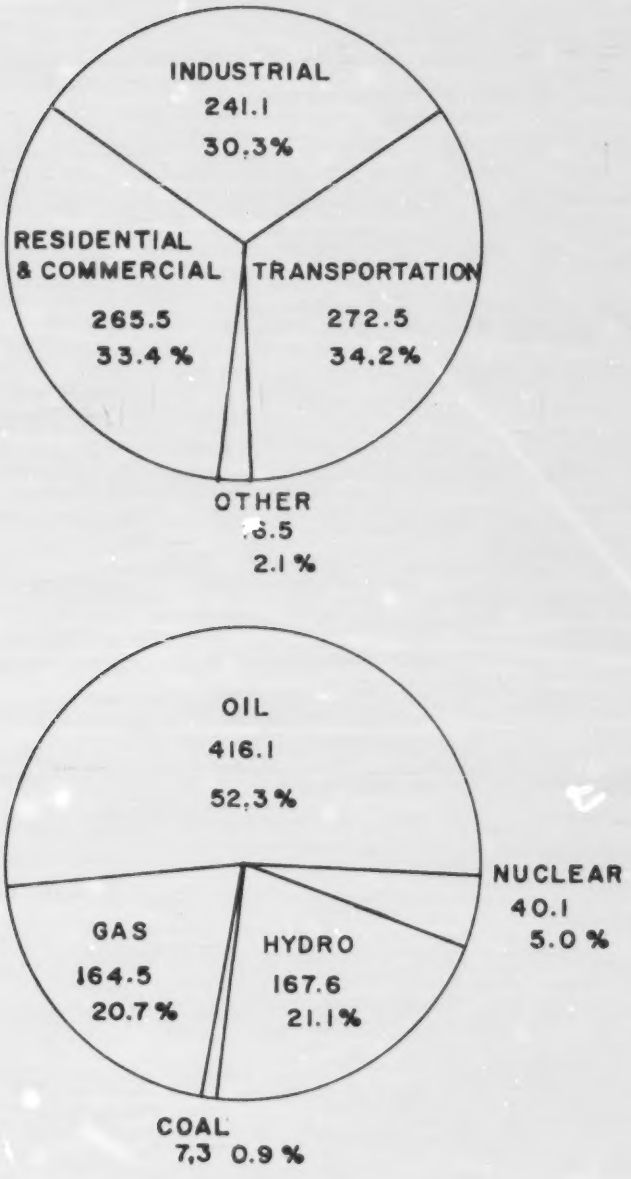


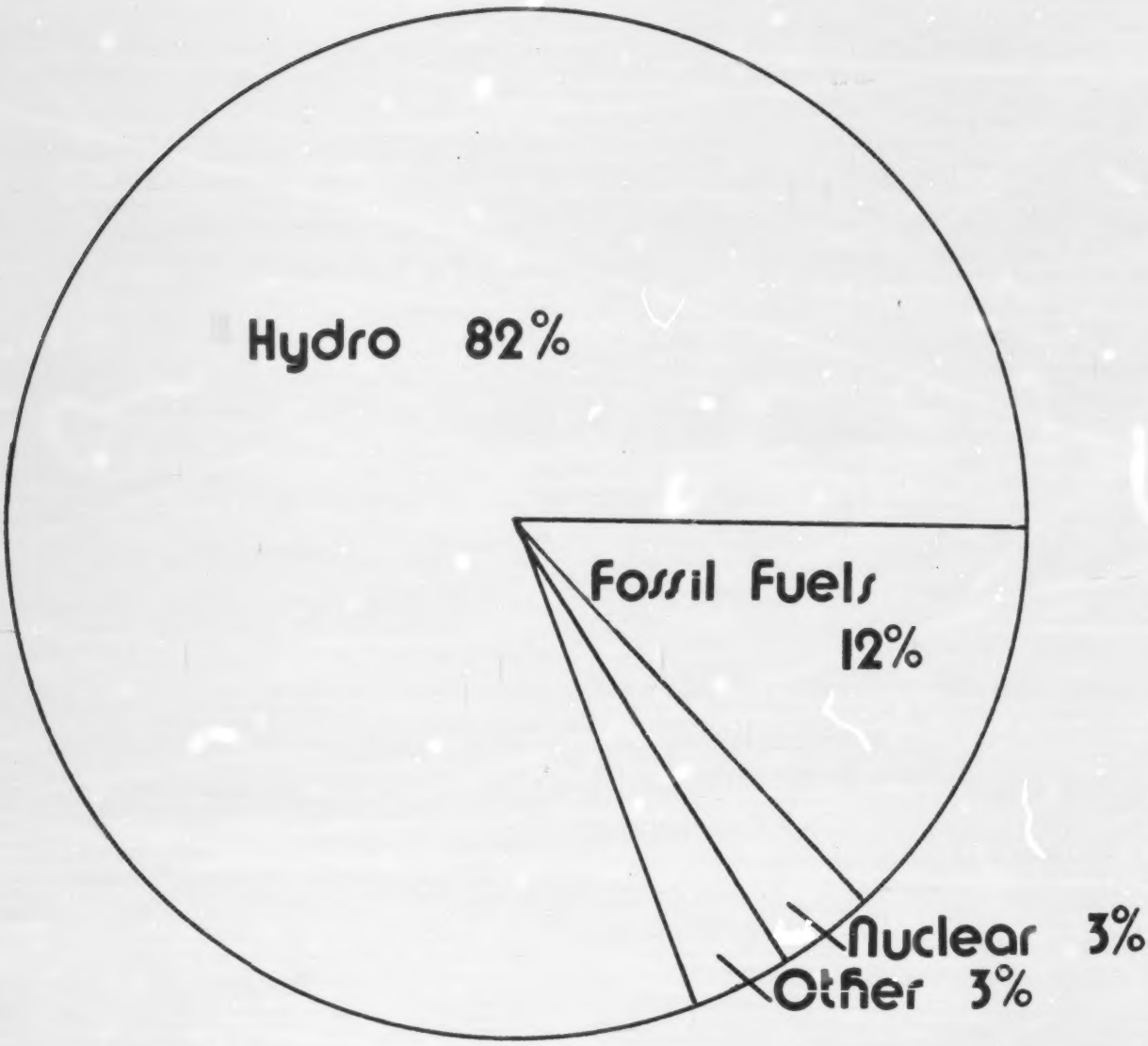
ENERGY CONSUMPTION IN THE STATE OF WASHINGTON

1971

(Total = 795.6 trillion Btu)

(trillions of Btu)

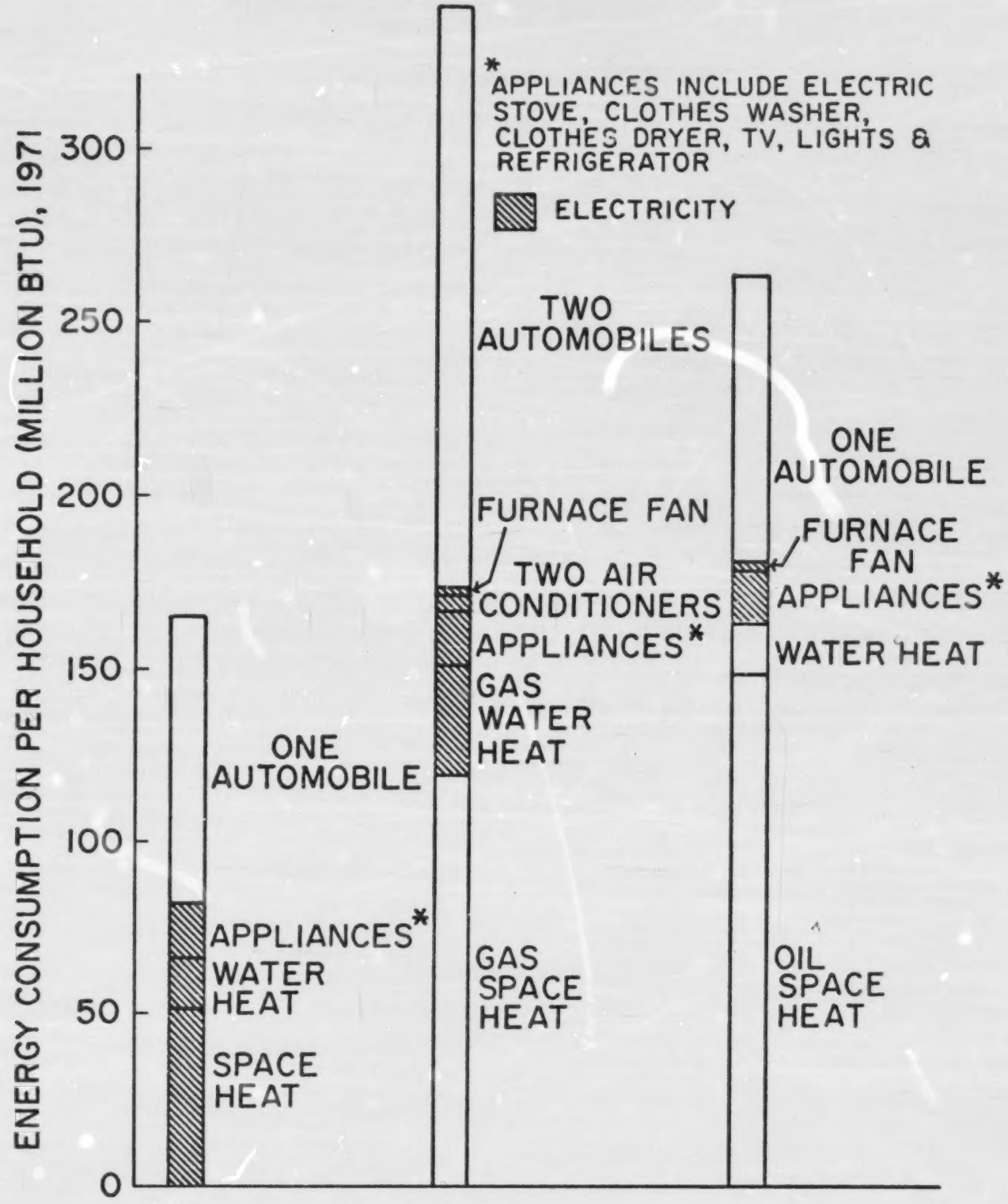




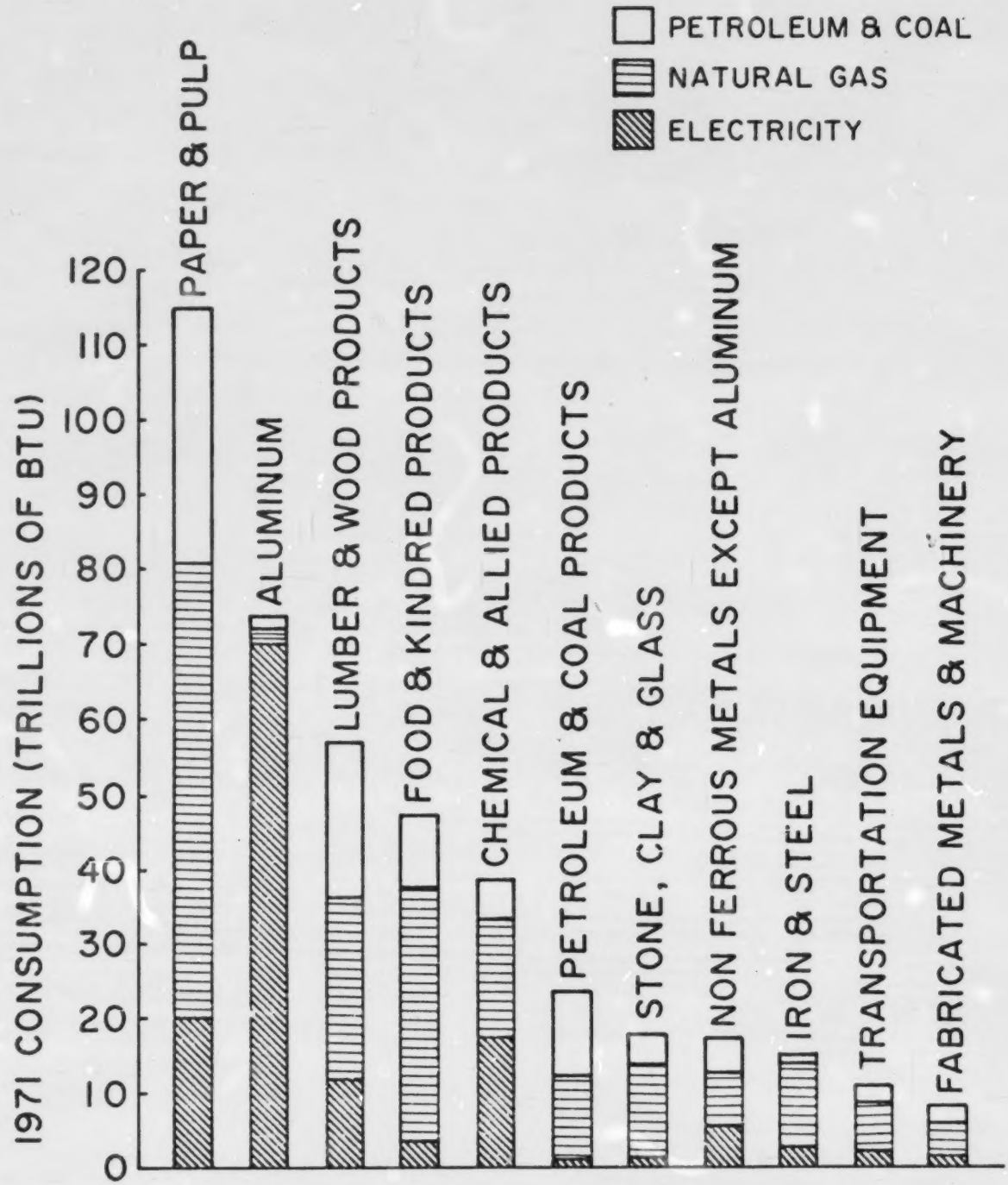
Northwest Electric Energy Sources

ANNUAL ENERGY BUDGETS FOR THREE HOUSEHOLDS IN THE PACIFIC NORTHWEST

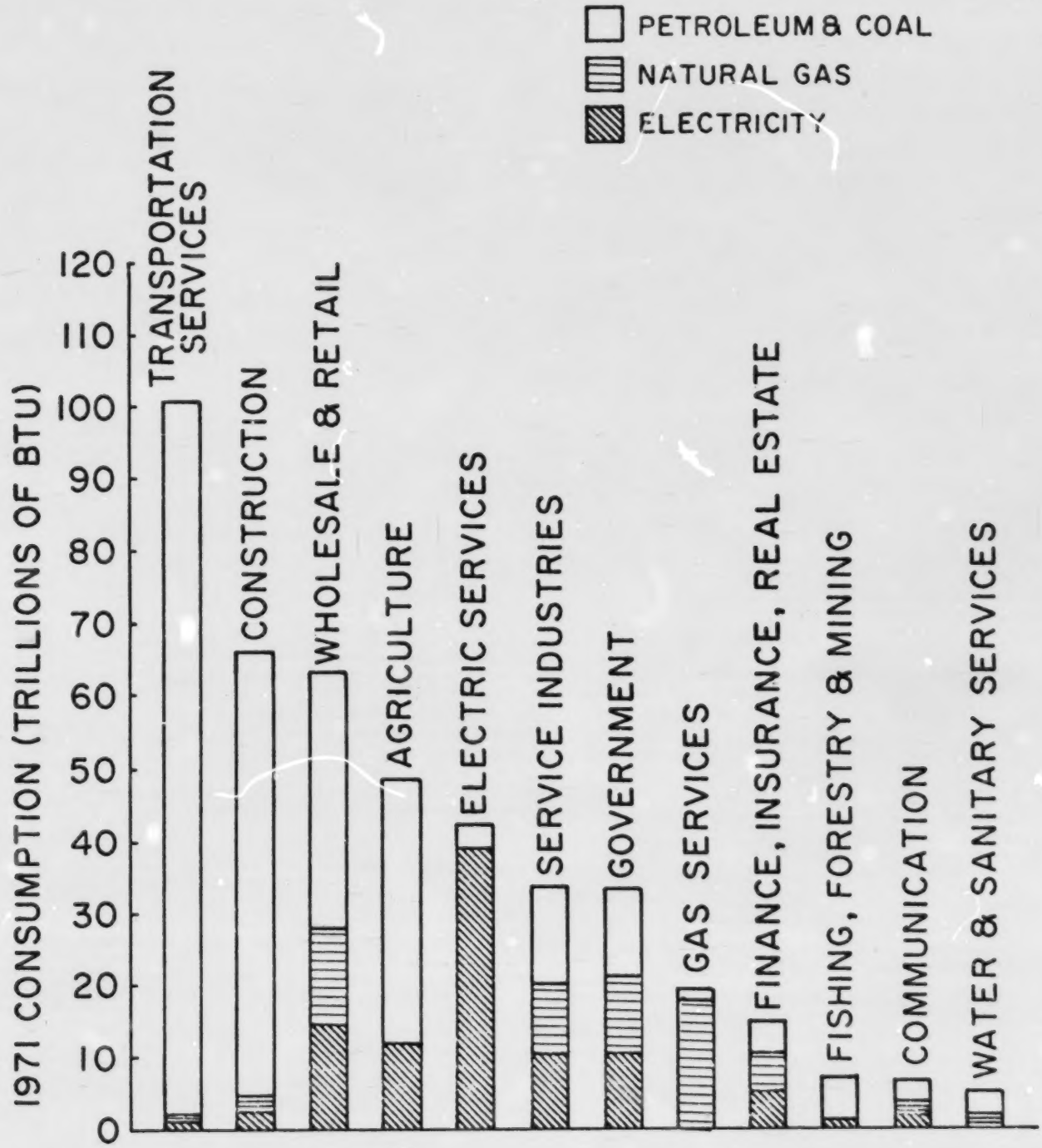
(USING AVERAGE UNIT CONSUMPTION FIGURES)

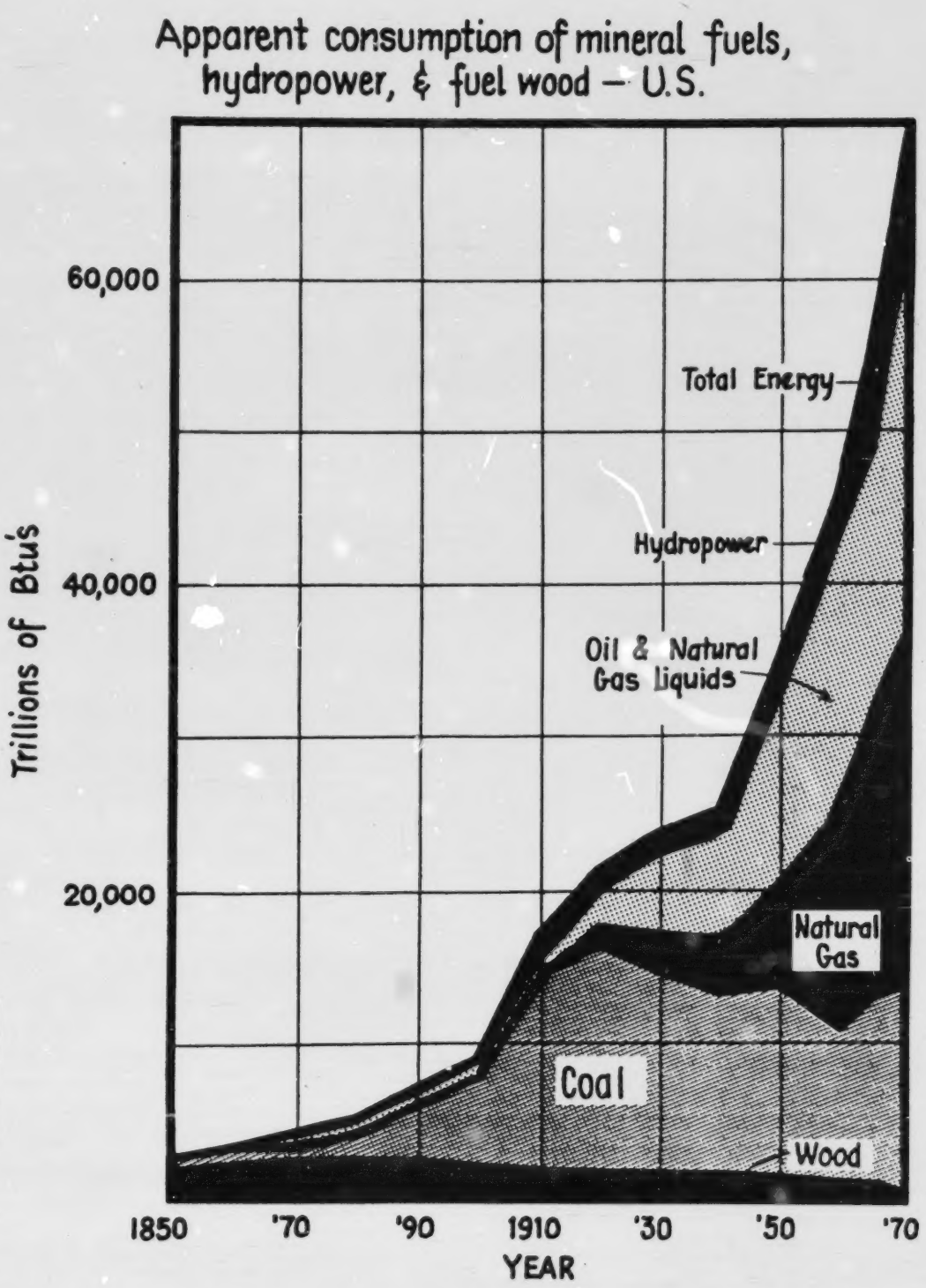


ENERGY CONSUMPTION IN PACIFIC NORTHWEST MANUFACTURING INDUSTRIES 1971



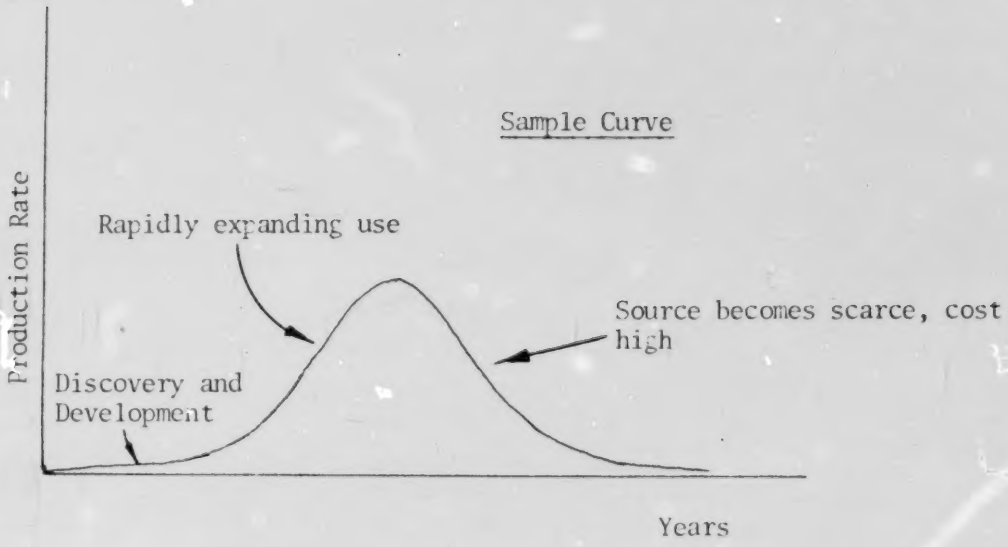
ENERGY CONSUMPTION IN PACIFIC NORTHWEST COMMERCIAL AND EXTRACTIVE INDUSTRIES





The Electric Energy Picture in the Pacific Northwest. U.S. Department of Interior, Bonneville Power Administration, April 1, 1973.

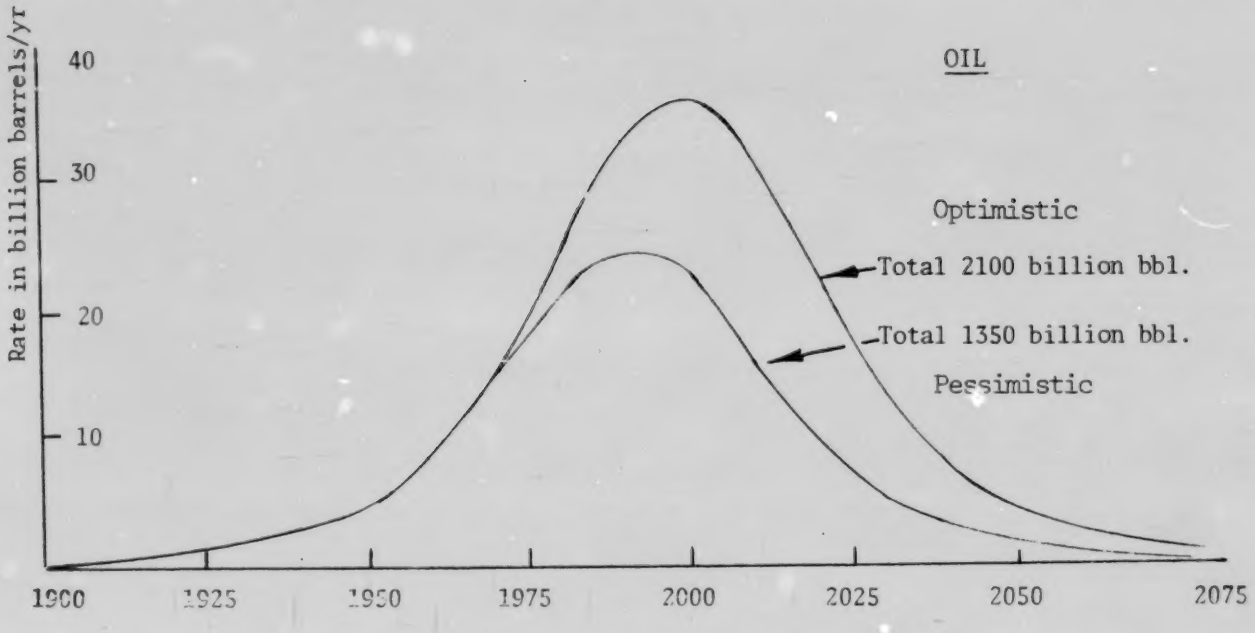
LIFE SPAN OF A DEPLETABLE RESOURCE

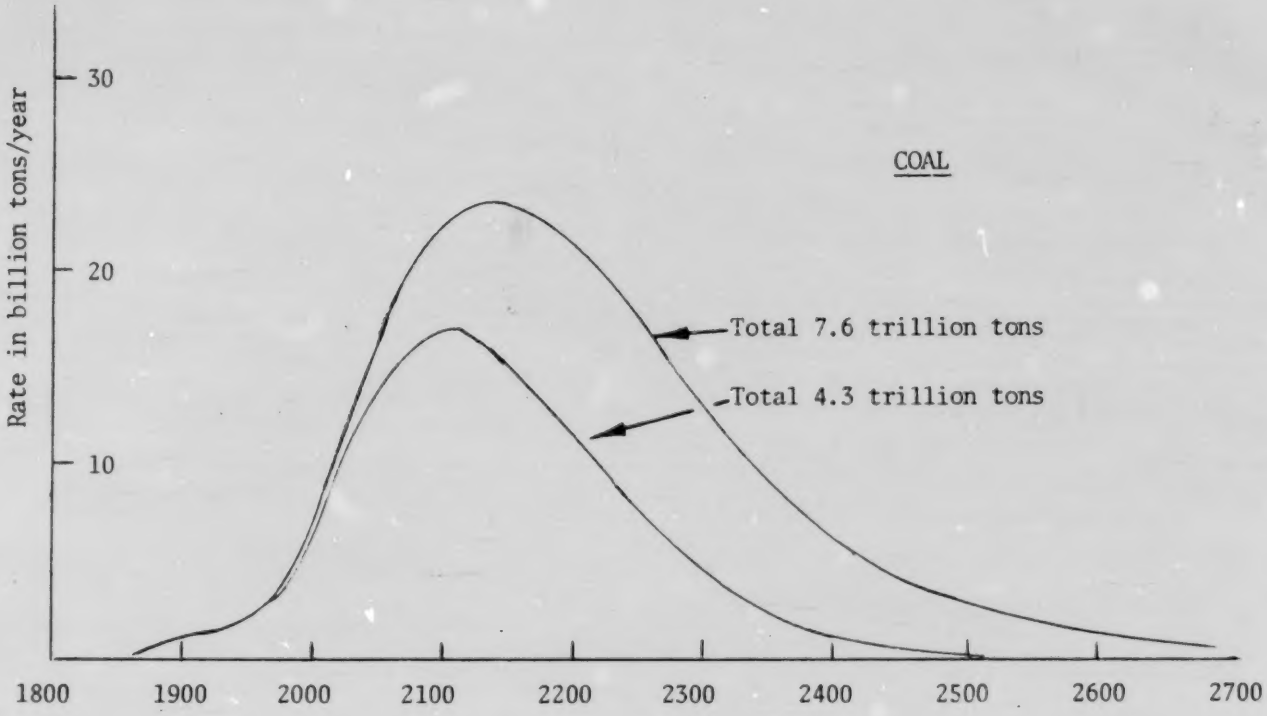


The area under the curve represents the total amount of the resource at the outset.

The curves on the following page represent petroleum and coal resources of the world. Note that for each resource, two curves are given, based on different estimates of the total amount of the resource available.

LIFE SPAN OF WORLD'S PETROLEUM AND COAL RESOURCES





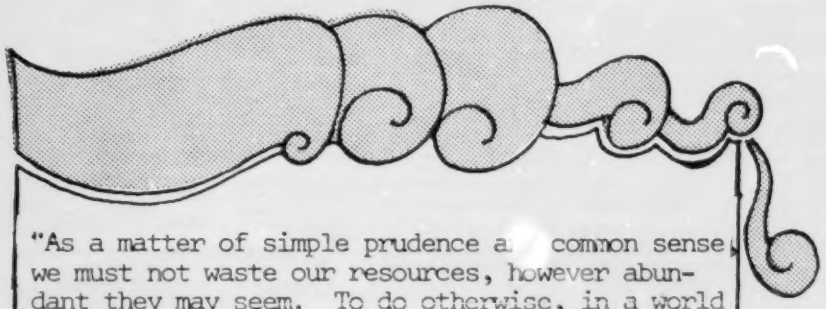
Based on a 1973 Department of the Interior publication U. S. Energy, and U. S. Energy Outlook, published in 1971 by the National Petroleum Council, the following table indicates one estimate of the available U.S.A. reserves of fossil fuels. These life expectancies are based on discovered and expected to be discovered resources, which reasonably can be procured with current technology:

LIFE EXPECTANCIES OF BASIC FUELS

	Potential Amounts	Use in 1971	Estimated Use in 1985	Life Expectancy
Natural Gas	2391 TCF	22 TCF	40 TCF	2030 A.D.
Petroleum	456 B Bbls.	5.5 B Bbls.	9.5 B Bbls.	2030 A.D.
Coal	390 B Tons	590 M Tons	1,071 M Tons	2300+ A.D.
Uranium	1.1 M Tons (Under $10/lb)	6,900 Tons	59,300 Tons	1995 A.D. no breeder. 2500+ with breeder.

TCF - Trillion Cubic Feet
B Bbls - Billion Barrels
M Tons - Million Tons
B Tons - Billion Tons

(Now check the tables in Limits to Growth on life expectancies of resources. Do you note any discrepancies?)



"As a matter of simple prudence and common sense, we must not waste our resources, however abundant they may seem. To do otherwise, in a world of finite resources, reflects adversely upon what we are as a people and a Nation."

President Richard M. Nixon
Message on Energy
June 29, 1973

ESTIMATED ANNUAL KWH USE
FOR VARIOUS ELECTRICAL APPLIANCES

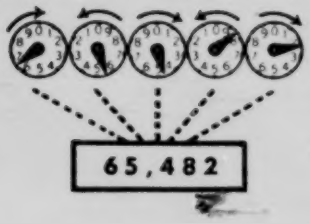
Note: These uses are those calculated for an average family of four for an average number of hours per year

Appliance	Average Watts	Hours of Operation Per Year	KWH Use
Air Conditioner (varies considerably with area, degree days and a family living habits)			
Window			935
Per 1000 BTU			135
Central			2400
Blanket	190	960	180
Bottle Warmer	500	72	36
Broiler	1400	70	100
Can Opener	10	5	1/
Carving Knife	95	8	8
Clock	2	8760	18
Clothes Dryer	4600	240	1100
Coffee Maker	800	180	145
Corn Popper	525	2	10
Dehumidifier	260	1460	380
Dishwasher 2/	1200	360	430
Egg Cooker	500	28	14
Fans			
Attic	370	785	290
Circulating	90	500	45
Kitchen	250	360	90
Roll-about	170	825	140
Window	200	850	170
Floor Polisher	350	70	25
Food Blender	350	36	125
Food Freezer - 15 cu. ft.			
Standard	350	3425	1200
Frost Free	440	4000	1760
Food Mixer	125	70	9
Food Warming Tray	350	200	70
Food Waste Disposer	450	65	30
Fry Pan	1150	300	345
Fryer, Deep Fat	1500	50	75
Furnace (varies considerably with area, degree days and family living habits)			
Oil	500	800	400
Gas	500	800	400
Electric			13500
Germicidal Lamp	20	7000	140
Griddle	1450	70	100
Grill, Sandwich	1160	30	35
Hair Curler	1100	100	110
Hair Dryer	400	60	25
Heat Lamp	250	60	15

Appliance	Average Watts	Hours of Operation Per Year	KWH Use
Heater			
Portable	1000	1080	1080
Radiant	1270	135	170
Heating Pad	65	120	8
Hot Plate	1250	72	90
Iron	1100	145	160
Ironer	1500	145	222
Lawnmower	1000	130	100
Lighting (varies with size of home & living habits)			1000
Night Light	10	2900	29
Post Light (Photo Cell)	100	4200	420
Projector			
Slide	500	50	25
Motion Picture	700	50	35
Radio			
Console	75	1400	125
Table	50	1400	70
Radio-phonograph	110	1000	110
Range	12000	100	1200
Self Cleaning Oven	4000	50	200
Razor	15	60	1
Record Player			
Console	160	300	50
Table	75	300	25
Recorder	100	100	10
Refrigerator - 12 cu. ft.			
Standard	240	3125	750
Frost Free	320	3800	1220
Refrigerator-Freezer - 14 cu. ft.			
Standard	325	3540	1450
Frost Free	360	5150	1850
Roaster	1320	360	475
Rotisserie	1400	360	500
Sewing Machine	100	120	12
Sun Lamp	300	50	15
Television			
Black & White	240	1500	360
Color	350	1500	525
Toaster	1150	48	55
Toothbrush	5	10	1/
Vacuum Cleaner			
Portable	210	60	13
Standard	600	120	70
Vibrator	40	50	2
Waffle Iron	1100	24	26
Washer 2/			
Automatic	500	200	100
Nonautomatic	285	200	75
Water Heater (varies considerably with clothes washing and bathing habits)			4800-9600

1/ Less than 1 kwh
2/ Does not include electricity to heat water.

HOW TO READ YOUR METER



Your electric meter is a precise, additive device which directly records the units of electricity (Kilowatt hours) used in your home. Each meter dial records one-tenth of the dial on its left; i.e., units, tens, hundreds, thousands and ten-thousands.

As an example, the above dials read 65,482. An electric bill would be determined by subtracting the previous reading from this reading to find the net kilowatt hours consumed between reading dates. To read a meter, start with the right hand dial and read left. The pointers on the first, third, and fifth dials move clockwise and counterclockwise on the second and fourth. If the pointer is directly on a number, read the next smaller number unless the pointer on the dial at its right has passed zero.

Energy Consumed in Typical Activities

	Kilocalories Per Hour
Sleeping	65
Sitting	100
Light exercise	170
Moderate exercise	290
Heavy work	450

Typical Energy Needs Per Day

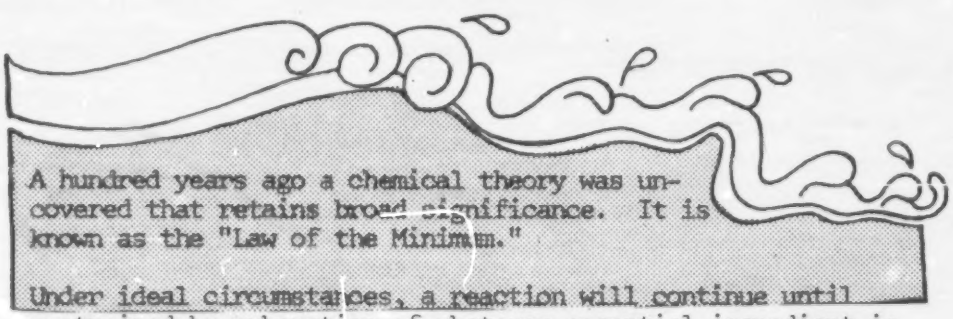
	Kilocalories
Child 10 to 12 years	2000
Woman doing light work	2200
Boy or Girl 14 to 16 years	2600
Man doing light work	3000
Man doing heavy work	4500

Energy Contained in Typical Foods

	Kilocalories per Kilo
Green vegetables: lettuce, cabbage,	150 to 350
Root vegetables: carrots, beets, potatoes,	400 to 1400
Legumes: dried beans, lentils,	1000 to 1300
Grains: flour, rice,	3500
Fish: cod, tuna,	1600 to 2000
Meat: poultry, lamb, beef,	2500 to 4000
Dairy products: milk,	675
cheese,	3800 to 4200
butter and vegetable oils,	7000 to 9000
Fruits: apples, bananas, oranges,	400 to 600
dried dates, figs,	2800 to 2900
Nuts: almonds, peanuts	5500 to 6500
Sweets: sugar, honey, candy,	3200 to 5200

The economy of the Pacific Northwest is based primarily on the extractive industries—forestry, agriculture, mining—associated processing sectors—food and kindred processing, lumber and wood, pulp and paper—and a few manufacturing sectors for which the region has unique attraction—aerospace and electroprocess metals. The remainder of the economy is made up of sectors that generally are supplying and serving the basic sectors and the residents of the region. Future growth of the economy might come from either further expansion or from diversification of the economy into other areas of manufacturing or into greater output in the trades and services.

Trends in economy play a very significant role in making decisions about careers. Job availability is controlled a great deal by economy as is evident in the projected trends in the following statistical material. When one chooses a career, the growth or decline of the job availability within that career will assist in the decision making process. The "value added" is a projection of the amount of money increase above the projected final output. A projection of less economic availability is evident in those areas in which the value added is a small percentage of the output and this in turn projects fewer career opportunities.


A hundred years ago a chemical theory was uncovered that retains broad significance. It is known as the "Law of the Minimum."
Under ideal circumstances, a reaction will continue until restrained by exhaustion of whatever essential ingredient is present in least supply.
What is our essential ingredient in least supply?
And how much of it do we possess?
We do not know.
S.P.R. Charter/Man on Earth, 1962

Field and Seed Crops

1970	Washington
Output	$ 170,500,000
Value added	113,200,000
Employ	17,600
1980	
Output	190,200,000
Value added	127,400,000
Employ	13,900

Vegetables, Fruit, & Other Agriculture

1970	
Output	213,100,000
Value added	185,400,000
Employ	21,900
1980	
Output	291,300,000
Value added	253,400,000
Employ	21,400

Mining (except Clay and Stone)

1970	
Output	14,400,000
Value added	9,000,000
Employ	500
1980	
Output	18,700,000
Value added	11,700,000
Employ	500

Canning, Preserving and Beverages

1970	
Output	705,800,000
Value added	276,000,000
Employ	15,700
1980	
Output	928,800,000
Value added	363,200,000
Employ	16,600

Livestock and Livestock Products

1970	Washington
Output	$ 236,300,000
Value added	86,000,000
Employ	24,800
1980	
Output	236,000,000
Value added	97,700,000
Employ	18,200

Forestry and Fisheries

1970	
Output	22,400,000
Value added	17,900,000
Employ	6,700
1980	
Output	38,900,000
Value added	31,200,000
Employ	7,000

Meat, Dairy Prod., Grain Mills, and other Food Processing

1970	
Output	939,000,000
Value added	208,500,000
Employ	13,100
1980	
Output	1,235,700,000
Value added	274,400,000
Employ	12,500

Textile and Apparel

1970	
Output	114,900,000
Value added	57,200,000
Employ	6,300
1980	
Output	160,300,000
Value added	79,800,000
Employ	11,400

Lumber and Wood

1970	Washington
Output	$1,039,000,000
Value added	443,300,000
Employ	35,900
1980	
Output	1,240,000,000
Value added	529,000,000
Employ	35,100

Plywood and Veneer

1970	Washington
Output	$ 235,100,000
Value added	86,500,000
Employ	7,300
1980	
Output	280,600,000
Value added	103,200,000
Employ	9,600

Paper and Allied Products

1970	
Output	898,700,000
Value added	458,900,000
Employ	19,800
1980	
Output	1,559,800,000
Value added	723,200,000
Employ	23,400

Printing and Publishing

1970	
Output	249,700,000
Value added	179,400,000
Employ	11,000
1980	
Output	380,600,000
Value added	273,500,000
Employ	12,600

Chemicals and Allied Products

1970	
Output	284,400,000
Value added	192,100,000
Employ	7,300
1980	
Output	374,700,000
Value added	253,200,000
Employ	8,300

Petroleum Refining and Related

1970	
Output	99,300,000
Value added	39,000,000
Employ	1,200
1980	
Output	123,200,000
Value added	48,400,000
Employ	1,700

Stone, Clay and Glass

1970	
Output	196,300,000
Value added	103,300,000
Employ	5,200
1980	
Output	295,100,000
Value added	155,200,000
Employ	6,500

Iron and Steel (includes Ferroalloys)

1970	
Output	222,300,000
Value added	82,700,000
Employ	3,300
1980	
Output	287,600,000
Value added	97,100,000
Employ	4,300

Other Primary Metals (nonferrous)

1970	Washington
Output	$ 164,500,000
Value added	54,500,000
Employ	1,600
1980	
Output	212,700,000
Value added	83,400,000
Employ	2,100

Aluminum

1970	Washington
Output	$ 569,000,000
Value added	207,000,000
Employ	9,300
1980	
Output	1,147,800,000
Value added	412,600,000
Employ	13,300

Fabricated Metals

1970	
Output	284,600,000
Value added	118,700,000
Employ	7,400
1980	
Output	367,700,000
Value added	153,400,000
Employ	9,200

Machinery

1970	
Output	379,100,000
Value added	220,500,000
Employ	14,400
1980	
Output	671,800,000
Value added	390,700,000
Employ	10,500

Aerospace

1970		
Output	3,389,400,000	
Value added	380,800,000	
Employ	61,500	
1980		
Output	5,321,700,000	(4,293,300,000)
Value added	552,400,000	
Employ	77,900	

Other Transportation Equipment

1970	
Output	734,000,000
Value added	187,100,000
Employ	13,300
1980	
Output	1,145,000,000
Value added	291,900,000
Employ	17,300

Other Manufacturing

1970	
Output	39,200,000
Value added	27,700,000
Employ	2,300
1980	
Output	62,400,000
Value added	44,100,000
Employ	2,700

Construction

1970	
Output	1,484,400,000
Value added	
Employ	53,300
1980	
Output	2,229,600,000
Value added	
Employ	58,200

Transportation	
1970	Washington
Output	$1,201,500,000
Value added	721,000,000
Employ	54,400
1980	
Output	1,310,700,000
Value added	791,400,000
Employ	61,500

Communications	
1970	Washington
Output	$ 328,700,000
Value added	263,000,000
Employ	18,000
1980	
Output	456,500,000
Value added	365,200,000
Employ	19,100

Electric Services	
1970	
Output	257,200,000
Value added	154,300,000
Employ	2,400
1980	
Output	361,500,000
Value added	216,900,000
Employ	2,700

Gas Services	
1970	
Output	141,800,000
Value added	48,200,000
Employ	1,500
1980	
Output	197,300.000
Value added	67,100,000
Employ	1,700

Other Utilities	
1970	
Output	153,200,000
Value added	39,800,000
Employ	1,500
1980	
Output	215,400,000
Value added	56,000,000
Employ	1,800

Trade	
1970	
Output	2,798,900,000
Value added	2,106,000,000
Employ	239,800
1980	
Output	3,937,100,000
Value added	2,976,400,000
Employ	390,900

Finance, Insurance, Real Estate	
1970	
Output	1,020,200,000
Value added	848,700,000
Employ	51,100
1980	
Output	1,459,400,000
Value added	1,214,200,000
Employ	83,100

Services	
1970	
Output	1,882,700,000
Value added	1,197,500,000
Employ	334,100
1980	
Output	2,961,400,000
Value added	1,871,600,000
Employ	428,100

GOOD THINGS TO READ

Adler, Irving

Energy. New York: John Day Company, 1970.

This book for intermediate students discusses what energy is; the different forms it takes; where it comes from, and how it is used. Simple illustrations clarify more difficult concepts. The book also includes a vocabulary list.

Anderson, Susan

What an Individual Can Do to Lessen the Strain on the Environment. Ecology Information Center, Sacramento, 1971.

A pamphlet that is interesting to read and is filled with lists of things we can do to lessen the strain on the environment and help meet the energy crisis. A good resource to have available for sudden discussion, or good filler discussions. Could be used by students for sources of reports and discussions--would be good for making speeches.

This pamphlet reads like the Guiness Book of World Records. I feel that it is good conversation reading. It is a good source to pick up and read when you have only a few minutes.

Bechtel, Jr., S. D.

Energy for the Future: New Directions & Challenges. Cincinnati: American Gas Association, 1972.

This is a reprint of an address given at a convention. The theme is that "in this country we are consuming substantially more energy than we are producing and there is strong evidence that this gap will widen a great deal over the next 20 years." The speaker went into detail examining some of the complexities and imponderables that frustrate a proper evaluation of alternatives. He also went into some ways for fulfilling near-term requirements 1973-1980, and then middle-term 1980-1995, and then long-term 1995 and thereafter. Then he set down some challenges facing us.

Commoner, Barry

The Closing Circle. New York: Alfred A. Knopf, Inc., 1971.

This book deals with the effects of man's use of energy on the environment. Dr. Commoner cites specific examples of pollution and their sources. A good source of material for teachers. Has Commoner's four laws of ecology as a focal point.

Darmois, Genevieve

Matter, Electricity and Energy. New York: Walker and Company, 1964.

States of matter are studied and the principal properties of the gaseous, liquid and solid states are discussed. Definition of energy, its different types, conservations and transformations.

Davis, Ira C. et al.

Science: Discovery and Progress. New York: Holt, Rinehart, Winston, 1970.

A very fine book for teaching energy and its nature. Probably a secondary level book but one that the elementary teacher can easily translate down to elementary level. An especially large section on energy and laws of energy. Fantastic activities for students. Again, many activities may be quite advanced for elementary students but a great number are very simple and easy for the teacher to demonstrate. Many activities to explain various laws of energy. Probably one of the best books for the science teacher to own or have immediate access to.

Eddy, Jr., William et al.

Consider the Process of Living. Washington, D.C.: Conservation Foundation, 1972.

Relates energy to living systems in a most understandable way. Not technical, with exceptional graphics. Junior-Senior High.

Educational Facilities Laboratories

The Economy of Energy Conservation in Educational Facilities. 477 Madison Ave., New York, N.Y. 10022, 1973, $2.00.

A report prepared with the aid of a panel of specialists--engineers, architects, a lighting consultant, and a school administrator--whose concern was to determine ways to save costs and conserve energy at three crucial times: when making operating and maintenance changes; when modernizing existing school facilities; when constructing new buildings. The report outlines criteria for assessing proposed energy-consuming systems such as heating, cooling, and lighting units. For further information, consult Danae Voltos, Educational Facilities Laboratories.

Fabun, Don

Dimensions of Change. Beverly Hills, CA: Glencoe Press, 1971.

An exceptionally fine job of depicting the role of energy in our world systems. Not at all technical, with outstanding graphics. A great book for visually oriented learners. Junior-Senior High.

Fowler, J. M. and K. M. Mervine

Energy and the Environment. University of Maryland; $ .75.

A kit of materials chiefly for science teachers but very readable by non-scientists. Contains a reprint of Fowler's article, "Energy and the Environment" from The Science Teacher, December 1972 dealing with:

1. Energy: Where it comes from and where it goes
2. Environmental Effects of Energy Use
3. Resources and New Sources

The kit also contains an excellent annotated bibliography to guide further reading.

Fuller, Buckminster

I Seem To Be A Verb. New York: Bantam Books, 1970.

A whole book of quotes relating to the environment and man's future. Many quotes from Fuller as well as a plethora of significant others. The best word to describe this book is Fuller's DYMAXION: maximum gain of advantage from the minimum energy input.

Goldsmith, Edward et al.

Blueprint for Survival. Boston, Mass.: Houghton Mifflin Co., 1972.

The author's premise: If we choose political remedies rather than ecological--we'll become extinct. He shows why our escalating economical way of life must collapse during our children's lifetime. He offers some alternate suggestions.

Hammond, Allen L. et al.

Energy and the Future. Washington, D.C.: American Association for the Advancement of Science, 1973.

A comprehensive introduction to each of the chief present and anticipated energy sources, the problems of delivering energy to the consumer, energy conservation, and energy policy matters.

Harrison, George Russell

The Conquest of Energy. New York: William Morrow & Co., 1968.

Mr. Harrison's book talks about the importance of energy in our society. He talks about the sources, transportation and utilization of power. He is especially concerned about energy sources for the future. He says our energy base will shift from fossil fuel to electric. Electricity will be produced by solar and nuclear energy. He seems especially favorable toward nuclear energy. Fairly objective--gives some good information--optimistic. Easy to read--recommended for adults. Index.

Herrera, Philip and John Holdren

Energy, A Crisis in Power. San Francisco, CA: Sierra Club, 1971.

America's appetite for energy--and particularly for electric power--is voracious. The authors of this publication predict the production of power will continue to double every ten years to meet the demand. They also warn of the damage being inflicted to the U.S. environment as fossil fuels pollute the air and hydropower plants destroy rivers.

Dr. Holdren, a scientist, examines the sources and consumption of energy and describes how the production of power leaves its mark upon the environment.

Philip Herrera, a journalist, reports on the efforts of concerned citizens to protect the environment from the ravages of power-triggered air, water and landscape pollution.

Hinkelbein, Albert

Energy and Power. New York: Franklin Watts, Inc., 1971.

Ten Chapters:

1. The Great Blackout
2. Energy
3. Solar Energy
4. Wind & Water
5. Heat
6. Heat Engines
7. Atomic Energy
8. The Transport of Energy
9. Storage, Control & Safety
10. Tomorrow's Energy Supplies

Irving, Robert

Energy and Power. New York: Alfred A. Knopf, Inc., 1965.

Written for elementary level. Discusses "We Work All the Time," "Work in Disguise," "Energy Circulates," "How Energy Travels," "Muscle Work," "Wind and Water," "Motion from Heat," "Electrical Power," "Energy of the Future." Tells about "the sources of energy and power; how man has tamed them and put them to work."

Meadows, Donella H. et al.

The Limits to Growth. New York: Universe Books, 1972.

An attempt to project the future of Man on Earth. The book challenges the concept that growth implies progress. A most insightful and controversial work. Highly recommended.

Puget Sound Power and Light Company

The Only Home We Have.

This booklet broadly discusses and outlines the development of man's energy use, and raises the question of how we will continue to use the energy available to us. It is presented in appealing graphic fashion which could be used effectively in junior high for the purpose of developing an open, questioning attitude toward the changes taking place in the ecosystem due to man's increasing utilization of energy resources.

Rocks, Lawrence and Richard Runyon

The Energy Crisis. New York: Crown Publishers, Inc., 1972.

An excellent book that discusses America's energy shortage, the whys of it, and what we have in store in the future in terms of change and adjustment of life style. Also deals with the politics that may result in the future.

Ross, Jr., Frank

Power and Energy. New York: Lothrop, Lee & Shepard Co., Inc., 1967.

Shelved in the juvenile section of the library, this book is, nonetheless, equally valuable as a resource for the teacher. Usable by the 4th or 5th grade, excellent reader, better for 6th grade and up.

A survey of our most important energy sources--the sun, wind, water, fossil fuels, chemicals, and the atom--and how man has made use of them over the centuries. Considers the limited supply.

Illustrated with photographs and drawings.

Although a good resource book, it is too technical for the average pupil. Children motivated in this direction will likely enjoy it and benefit from it.

Scientific American

The Biosphere. New York: Scientific American, September, 1970.

An eleven article issue on the Grand Cyclic mechanisms of life (and energy flow) on the earth. Next best Scientific American for illustrations and content in comparison to the Energy and Power issue. Highly recommended.

Scientific American

Energy and Power. W. H. Freeman, Co., September, 1971.

Entire issue devoted to energy. This is THE most outstanding resource available. Some parts are quite technical, but on the whole, a most readable source book. In print now as a paper cover book.

Sterland, E. G.

Energy Into Power - The Story of Man and Machines. Garden City, N.Y.: Nature Science Library, 1967.

This book has a chapter on the sources of energy. It has excellent charts and picture drawings showing the composition of atoms and other abstract ideas.

It also has an excellent chapter on kinetic energy in fluids. There are also chapters on the turbine and the air breathing engines. There is also a section on looking ahead and looking at some of the existing problems. This is an excellent reference book for the average 6th grade student.

Taylor, Gordon R.

The Doomsday Book. New York, N.Y. and Cleveland, Ohio: The World Publishing Co., 1970.

This book is readable and interesting. It has a lot of general easy to understand information with about a third of the book dealing with energy. There are more than four pages of references for more specific data.

Wilson, Mitchell and the Editors of Time-Life Books

Energy. New York: Time-Life Books, 1967.

Explanation of the role of energy in the universe and how matter is transformed into energy. The basic types of energy are described including heat, light and electricity.

Winger, John G. et al.

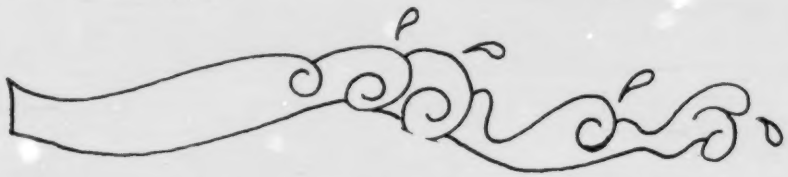
Outlook for Energy in the U.S. in 1985. Energy Economics Division, Chase Manhattan Bank, 1972.

A booklet that presents all the basic facts in a most readable format. A valuable resource. Junior-Senior High-up.

Woodburn, John H.

The Whole Earth Energy Crisis. Putnam, 1973. Grades 6-up.

There seems to be no limit to the expanding productivity and population of the world. Unfortunately, the sources of energy needed to make the wheels turn are definitely limited at the present time. What will happen when the coal and petroleum, which are today's main energy sources, run out? John H. Woodburn tells the absorbing story of where the world's energy comes from and of the difficult decisions that face all of us as the earth's resources are used up.



The greatest use of water by man is for cropland irrigation. A farmer needs 60 gallons of water in order to bring one pound of wheat to harvest. Rice, a crop that feeds more people in the world than any other, requires 200 to 250 gallons of water for every pound grown. During the growing season, a single corn plant needs more water daily than the human body . . .

. . . Since man's primary concern with feeding and watering livestock lies in some specific end-product such as milk or meat, it is more meaningful to speak of the total amount of water required to produce these essential commodities. Approximately 1000 gallons of water, for instance, are required to produce a single quart of cow's milk, while from 2500 to 6000 gallons are necessary to produce each pound of meat.

"Consider the Process of Living"

Conservation Foundation

A FEW FILMS

ATOMIC POWER PRODUCTION

PRODUCED: Handel Film Corporation
LENGTH: 14 minutes -- color — FILM
GRADE: junior high level, upper elementary

This film points out the growing demand for electrical power. It also clearly shows the need for harnessing nuclear energy. The film is animated and also discusses power reactors and their differences. Although the film goes into the design, safety, maintenance and operation of atomic power plants, there is much information which 6th graders can comprehend

ATOMIC POWER TODAY: SERVICE WITH SAFETY

PRODUCED: 1966
LENGTH: 28 minutes -- color — FILM

Atom-energy presented as an important source of electric power. Shows how atomic fuel units are assembled, how a power plant is built with the greatest possible safety, the disposal of used fuel units, etc.

EARTH: MAN'S HOME

PRODUCED: Encyclopedia Brittanica
LENGTH: 10 minutes — color — FILM
GRADE: 1 - 4

Explains that air, food, water and a certain temperature range are essential to man's survival. Discusses reasons why some areas of the earth's surface are more densely populated than others. Shows that man has adapted to his surroundings in different ways all over the world.

ELECTRICITY -- ALL ABOUT US

PRODUCED: Coronet Films, 1958
LENGTH: 11 minutes -- color -- FILM
GRADE: 3 - 6

By observation and experiment, Jean learns the characteristics of static electricity, an electrical circuit, and the ways electricity is generated. Illustrated are the operation of the dry cell circuit, conductive materials and those used for insulation, and the importance of electricity in the home and in industry.

ENERGY AND LIVING THINGS

PRODUCED: 1972 - Centron education films
LENGTH: 10 1/2 minutes -- color
GRADE: K - 8

This elementary school film is marked by its simple and useful explanation of the concepts of matter and energy. Sufficient information is presented about why all living things need energy. Effective teaching techniques make this film particularly informative for young audiences.

ENERGY AND MATTER

DISTRIBUTOR: Contemporary/McGraw Hill Films
PRODUCED: National Film Board of Canada -- 1967
LENGTH: 9 minutes -- color
GRADE: 4 - 8

Skillful combination of color photography and animation with an excellent script make "Energy and Matter" a top-rate introduction to a few important energy concepts, including the sun as the source of it all; the ability of energy to change from one form to another; the fact that energy and matter are essentially one and the same.

ENERGY AND WORK

LENGTH: 11 minutes -- black and white -- FILM
GRADE: 6

This film teaches that work means using energy to make an object move, or to make it stop moving. It takes energy to do work. All energy can do work.

ENERGY AND WORK

PRODUCED: E.B.E., 1961
LENGTH: 11 minutes -- color -- FILM

Basic Physical Science Series — about the physical aspect of energy -- work, stored energy, energy conversion, etc.

ENERGY CRISIS

PRODUCED: Journal, 1972
LENGTH: 12 minutes — color -- FILM

Different energy sources and their future -- shows different ways to generate electricity and emphasizes each method's limitations. Ends with nuclear reactors.

FOSSIL STORY

PRODUCED: Shell Oil Co., 1953
LENGTH: 10 minutes — black and white — FILM
GRADE: 4 - 6

Pictures various types of fossils. Their use by scientists to learn of life on the earth in prehistoric ages is shown as well as their value to the oil industry in the search for new resources.

GARBAGE

PRODUCED: King Screen, 1969
LENGTH: 10 minutes — color — FILM
GRADE: 4 - 12

An involvement film without words. A powerful visual indictment against littering suggesting that there is a tragic comic quality about man ... even his garbage.

GREAT RIVER

DISTRIBUTOR: U. S. Department of Interior, Bureau of Reclamation, 1963
LENGTH: 28 minutes — color
GRADE: junior high - up

Made for the Bureau of Reclamation and Bonneville Power Administration, U. S. Department of the Interior.

Everything that can be done to, or taken from, a major waterway is shown in "Great River". The Columbia River system is leashed by more than 140 dams. The largest harness, Grand Coulee's hydroelectric system emits a steady flow of 2 million kilowatts of power. All aspects of the Columbia's potential are covered.

HEAT AND HOW WE USE IT

LENGTH: 11 minutes — color — FILM
GRADE: 1 - 4

Provides basic understanding about heat — its sources, the ways in which it travels, and its many uses in every day living. Explains how heat is reflected or absorbed by various materials; how temperatures are measured; and how heat expands things such as metals, liquids, and air.

HEAT AND TEMPERATURE

PRODUCED: Coronet Films
LENGTH: 13 - 1/2 minutes — color — FILM
GRADE: 4 - 12

This film shows experiments clarifying the definition of heat as energy transfer rather than a form of energy. Standard units are used to measure heat output of a space heater, cooling capacity of an air conditioner and caloric output of a piece of cake.

HOW ELECTRICITY IS PRODUCED

PRODUCED: 1960
LENGTH: 11 minutes -- color — FILM
GRADE: 4 - 6

Explains how electricity is produced. The main part of the film is photographed at a hydro-electric plant, shows how mechanical energy is converted into electrical energy, using the principle discovered by Faraday.

MOUNTAIN WATERS

AVAILABLE: Classrooms Unlimited, catalog
PRODUCED: 1959
LENGTH: 16 minutes — color — FILM
GRADE: 3 - 8

Tells story of water storage and water uses. Water is shown held for storage for power, irrigation, flood control and recreation. Shows Ross Dam and Lake, Bonneville Dam.

MOVING THINGS ON LAND

LENGTH: 11 minutes — black and white -- FILM
GRADE: 4 - 5

Various ways people have devised to reduce friction in moving things. Friction's usefulness is also dramatized by an imaginary excursion into a startling world where it does not exist.

POWERLINE: TRANSPORTATION OF ENERGY

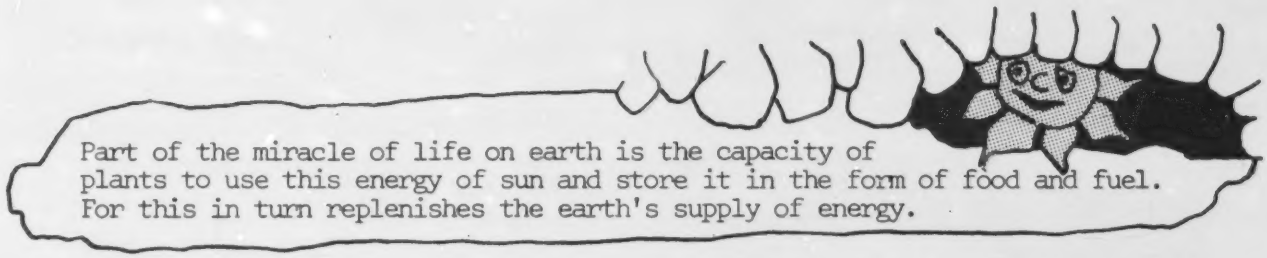
PRODUCED: Arthur Barr, 1960
LENGTH: 11 minutes -- color -- FILM
GRADE: 4 - 9

This film shows the transportation of energy from generating plants to substations over powerlines. It points out the function of the substation to control and distribute the energy, emphasizing the resources needed to deliver power.

SCIENCE -- ENERGY ENVIRONMENT -- ARK

AVAILABLE: Intermediate School District, No. 110
PRODUCED: Barr, 1970
LENGTH: 20 minutes -- color -- FILM
GRADE: 5 - 12

A drama about what the future may hold for man if he does not face up to his environmental problems.


Part of the miracle of life on earth is the capacity of
plants to use this energy of sun and store it in the form of food and fuel.
For this in turn replenishes the earth's supply of energy.

ENERGY ARITHMETIC

Power

The basic unit of power is the watt. For an electrical appliance the power rating is found by multiplying the voltage by the current (in amperes). Thus, a 125 volt appliance drawing 10 amperes has a power rating of 1250 watts. The kilowatt is simply 1000 watts and a megawatt is a million watts (10^6 watts). The horsepower is equivalent to 746 watts.

We can summarize these facts as follows:

number of watts = voltage x current

1 kilowatt = 1000 watts = 10^3 watts

1 megawatt = 1,000,000 watts = 10^6 watts

1 horsepower = 1 hp = 746 watts

Energy

The basic unit we shall use for energy is the kilowatt-hour (kwh), which is the energy used when a device rated at 1000 watts operates for an hour (or a 100 watt appliance operates for 10 hours). The table below gives various equivalents.

UNIT OF PROCESS	NUMBER OF KWH
Calorie (diet)	.0012 (1.2×10^{-3}) small
Calorie (ordinary)	1.2×10^{-6} (.0000012) smaller
BTU (British Thermal Unit)	2.9×10^{-4} (.00029)
One hour manual labor	.06
Combustion of 1 gallon of gasoline	38.3
Heat one gallon of water $1^{\circ}F$	.0024

A cubic foot of water falling 14 feet per second produces a kilowatt, enough power to light ten hundred-watt lamps.

GOVERNMENT REPORTS

Availability of documents varies. Those listed as depository items may be found in federal depository libraries. Priced items may be ordered from the Superintendent of Documents, Washington, D.C. 20402, while unpriced items must be requested directly from the issuing agency. Senate documents orders go to the issuing committee, U.S. Capitol, Washington, D.C. 20510, and House documents follow suit, only to zip code 20515.

U.S. Congress. 92nd House. Comm. on Interior and Insular Affairs.
ENERGY "DEMAND" STUDIES: AN ANALYSIS AND APPRAISAL. 1972. 71p. (Committee print).
Sudocs no. Y4.In8/14:En2.
Examines "thirty-five recent energy demand studies. . . representative of most of the major efforts to forecast energy demand which have been made in the last decade." Notes that the "forecasts of most so-called energy demand studies are basically just extrapolation of historical trends in energy consumption," and that this methodology is open to criticism. Concludes that most of the forecasts are "of limited usefulness," in spite of the fact that they represent the best available. An excellent, highly thought-provoking study.

U.S. Congress. 92nd House. Comm. on Science and Astronautics. Subcomm. on Science, Research, and Development. Task Force on Energy.
ENERGY--THE ULTIMATE RESOURCE; study submitted . . . by the Environmental Policy Division, Congressional Research Service, Library of Congress. 1971. 212p. (Committee print serial J).
Sudocs no. Y4.Sci2:92-1/J.
"Attempts to describe the history and present status of world energy production and consumption, and show where research and development fit into the overall energy policy issue." In this "desk reference book . . . the data have been organized under broad topics," e.g., energy use and GNP, comparison of energy reserves, oil and gas, transportation of energy, future energy demand. A key work.

U.S. Congress. 91st. Joint Economic Comm.

THE ECONOMY, ENERGY, AND THE ENVIRONMENT; a background study prepared . . . by the Environmental Policy Division, Legislative Reference Service, Library of Congress. 1970. 131p. (Joint committee print).

Sudocs no. Y4.Ec7:Ec7/24. 55¢.

"Surveys the existing literature relating to various technical aspects of electric power production, with primary emphasis on the supply of the various fuels used in the production of electricity and on the environmental consequences of energy conversion." Provides a brief overview of the situation, followed by a systematic and comprehensive look at specific aspects. Many pertinent tables. Bibliographies. Excellent.

U.S. Congress. 92nd. Senate. Comm. on Interior and Insular Affairs.

A REVIEW OF ENERGY POLICY ACTIVITIES OF THE 92ND CONGRESS, FIRST SESSION; prepared . . . pursuant to S.Res. 45, a National Fuels and Energy Policy Study. 1972. 180p. (Committee print 92-17).

Sudocs no. Y4.In8/13:92-17.

Suggests six major causes of the energy crisis, viz., growth in population and per capita consumption, development of environmental quality goals, natural gas shortage, oil imports, coal availability, and electric power generation. Reports on legislative actions and committee hearings. Provides synopses of selected energy and fuels reports, and states emerging issues. Appendices include texts of selected documents. Excellent.

U.S. Congress. 92nd. Senate. Comm. on Interior and Insular Affairs.

SUMMARY REPORT OF THE CORNELL WORKSHOP ON ENERGY AND THE ENVIRONMENT, FEB. 22-24, 1972; sponsored by the National Science Foundation Research Applied to National Needs (RANN) Program . . . pursuant to S.Res. 45, a National Fuels and Energy Policy Study. 1972. 177p. (Committee print 92-23).

Sudocs no. Y4.In8/13:92-23. 70¢.

An overview of energy and the environment is followed by four parts: (1) social, environmental, and health costs, (2) technological options, (3) growth rate of energy demand, and (4) institutional mechanisms. Concludes that "the important immediate objective to be achieved . . . is to equip the federal government with a basic set of institutions which can function effectively under dynamic conditions in response to the preferences of a full range of interests in our society." An excellent report.

U.S. Congress. 91st. Senate. Comm. on Public Works.

SOME ENVIRONMENTAL IMPLICATIONS OF NATIONAL FUELS POLICIES. 1970. 70p. (Committee print).

Sudocs no. Y4.P96/10:N21f. 30¢.

"An objective analysis of the factors relevant to the development of fuels and energy policies compatible with environmental quality

requirements." Focuses upon two general considerations, viz., "that in the conversion of fuel to energy, all processes result in some types of effluents being released to the environment," and "that fuel supplies are all to some extent limited." Appendix B contains an annotated list of federal programs related to the environment. An excellent brief report.

MAGAZINE ARTICLES

As with most contemporary issues, the media can be the best source of available information. Collect clippings, articles and reports on the status of energy resources.

We won't even try to specify articles. There are just too many available. The list of periodicals that follows contains some superb material on energy from the past one to two years. Almost any issue you pick up has some commentary about energy.

Atlantic
Audubon
Bulletin of the Atomic Scientists
Fortune
Harpers
National Geographic (Especially November 1972)
National Wildlife Magazine
Newsweek
The Plain Truth
Science (AAAS)
The Science Teacher
Scientific American
Sierra Club Bulletin
Time Magazine
U.S. News and World Report
Your local newspapers
Weekly Reader

Don't stop here. What other periodicals can you find that have material related to energy?

GLOSSARY OF ENERGY RELATED TERMS

(More than you'll ever want to know)

ACRE-FOOT: A volume of water one foot in depth covering an area of one acre.

AMPERE: Unit of electric current approximately equivalent to flow of 6×10^{18} electrons per second.

AMPERE-HOUR: The amount of electricity flowing per hour through a conductor when current in it is one ampere.

BOILING-WATER REACTOR (BWR): A type of nuclear power reactor in which the steam produced by water flowing through the core is used to drive a turbine directly.

BREEDER REACTOR: A nuclear reactor which produces more fuel than it consumes. In such a reactor the reactor core is surrounded with a "blanket" of fertile material such as uranium-238 or thorium-232, materials which are not fissionable naturally. Neutrons in excess of those required to sustain the fission chain reaction in the core enter the nuclei of atoms of the fertile material and render such nuclei fissionable and, therefore, useful as fuel for other reactors.

BRITISH THERMAL UNIT (BTU): The amount of energy necessary to raise the temperature of 1 pound of water by 1° Fahrenheit at or near 39.2°F.

CALORIE: Unit of quantity of heat. The amount of heat required to raise the temperature of 1 gram of water through 1 degree Centigrade.

CIRCUIT: The complete path traversed by an electric current.

COAL: A solid, combustible, organic material formed by the decomposition of vegetable material without free access to air.

COAL GAS: An artificial gaseous fuel produced by heating coal in the absence of oxygen. This fuel, known as town gas, can supply about 450 BTU per standard cubic foot. Use of coal gas in the U. S. ceased when inexpensive natural gas became widely available.

COMBUSTION: Burning.

CONDUCTION, THERMAL: The transmission of heat through a substance from places of higher to places of lower temperature.

CONDUCTOR, ELECTRICAL: Body capable of carrying an electrical current.

CONSERVE: Save.

CRUDE OIL: Petroleum liquids as they come from the ground. Petroleum liquids were formed from animal and vegetable material which collected at the bottom of ancient seas.

CURIE (Ci): The unit of radioactivity. Any quantity of radioactive material in which 37 billion atoms are disintegrating every second is said to have an activity of 1 curie.

DEUTERIUM: A form of hydrogen atom in which the nucleus contains one proton and one neutron. About 0.0156% of all hydrogen atoms have such nuclei. Deuterium is expected to be the primary fuel for fusion power plants.

DIESEL OIL: The oil left after petrol and kerosene have been distilled from crude petroleum.

ELECTRIC CURRENT, HEATING EFFECT: When an electric current flows through a conductor of finite resistance, heat energy is continuously generated at the expense of electrical energy.

ELECTRIC POWER: The rate of doing work. Measured in watts.

ELECTRICAL ENERGY: The energy associated with electric charges and their movements. Measured in watt hours or kilowatt hours. One watt-hour equals 860 calories.

ELECTROMETER: Instrument for measuring voltage differences.

ELECTRON VOLT (eV): A unit of energy equal to the kinetic energy gained by an electron as it moves through a potential difference of 1 volt.

ENERGY: Energy is the capacity for doing work, and, therefore, energy and work are measured in the same units. Commonly used units of work and energy are the joule, BTU, calorie, foot-pound, electron volt, watt-hour, and kilowatt-hour (kwh). Forms: potential, kinetic, electrical, heat, chemical, nuclear and radiant.

ENERGY MIX: The variable combination of energy sources in a locale or region. Electrical energy in Washington is supplied by a mix of hydroelectric nuclear and fossil (oil, coal) fuels.

EXPONENTIAL GROWTH: A quantity exhibits exponential growth when it increases by a constant percentage of the whole during a constant time period. A colony of bacteria in which each bacterium divides into 2 bacteria every 10 minutes grows exponentially.

FAHRENHEIT DEGREE: 1/180 of the difference between the temperature of melting ice and that of water boiling under standard (760mm.) atmospheric pressure.

FAST BREEDER REACTOR: A breeder reactor in which the breeding neutrons are traveling at high velocities. The principal nuclear reaction envisioned for most proposed fast breeders is conversion of non-fissionable U-238 to fissionable plutonium-239.

FISSION: The splitting apart of an atomic nucleus into two smaller nuclei. The process is initiated by the capture of a neutron by the nucleus of a fissionable atom. The fissioning nucleus, in turn, emits one to three neutrons which can initiate fission in other nuclei, and produce a chain reaction.

FUEL: A substance used to produce heat energy, chemical energy by combustion or nuclear energy by nuclear fission.

FUEL OILS: Fuel oils are the petroleum fractions with a higher boiling range than kerosene. They are generally classified as distillates or residuals. Distillates (Nos. 1, 2 and 4) are the lighter oils used primarily for central heating of homes, small apartment houses, commercial buildings, and for transportation. Residuals (Nos. 5 and 6), often called bunker oils, are heavier, high viscosity oils which usually need to be heated before they can be pumped. They are used in industry, large commercial buildings, and for the generation of electricity.

FUSION: The process in which two atomic nuclei combine to form a larger nucleus whose mass is less than the aggregate mass of the original nuclei. The lost mass appears as energy. Because of repulsive electrical forces between their protons nuclei will not combine unless they are traveling toward one another at tremendous velocities. Initiation of the process, therefore, requires very high temperatures.

GAS-COOLED REACTOR (GCR): A type of nuclear power reactor in which a gas, usually helium, flows through the reactor core, becomes heated, and then gives up its heat to produce steam in a separate vessel. The steam is then used to drive a turbine.

GAS TURBINE: An engine which converts chemical energy of liquid fuel into mechanical energy by combustion. Gases resulting are expanded through a turbine.

GENERATOR: A machine for producing electrical energy from mechanical energy.

GEOTHERMAL ENERGY: Heat energy in the crust of the earth believed to have been produced by natural radioactivity. The thermal gradient of the earth's crust is such that the temperature in a deep well or mine increases by about $1^{o}F$ for each 100 feet of depth. At a place where the average surface temperature is $50^{o}F$ a temperature of about $212^{o}F$ could be expected at a depth of about 16,000 feet.

HEAT: Energy possessed by a substance in the form of kinetic energy, usually measured in calories--in space heating by the British Thermal Unit. Heat is transmitted by conduction, convection or radiation.

HEAT PUMP: A device which transfers heat from a colder to a hotter reservoir by the expenditure of mechanical energy when the primary purpose is heating the hot reservoir rather than refrigerating the cool reservoir. A heat pump is a reversed refrigeration apparatus. Heat pumps are far more efficient for residential heating than electrical resistive heating.

HIGH TENSION: High voltage.

HORSE-POWER: British unit of power. 1 H.P. = 746 watts.

HYDRO: Prefix denoting water.

HYDROELECTRIC: Electricity production by water-powered turbine generator.

INTERNAL-COMBUSTION ENGINE: Energy is supplied by a burning fuel which is directly transformed into mechanical energy by controlled combustion.

KEROSENE: The petroleum fraction containing hydrocarbons that are slightly heavier than those found in gasoline and naptha, with a boiling range between 180 and 300°C. Used today as fuel for gas turbines and jet engines.

KILOWATT (kW): The unit of power equal to 1000 watts. Roughly a power of 1 kw is capable of raising the temperature of a pound (pint) of water 1°F in one second.

KILOWATT-HOUR (kW-h): The amount of work or energy delivered during the steady consumption of 1 kilowatt of power for a period of 1 hour.

LIQUEFIED NATURAL GAS (LNG): Natural gas that has been cooled to about - 160°C for storage or shipment as a liquid. Liquefaction greatly reduces the volume of gas and, thus, the cost of shipping and storage is reduced.

LIQUEFIED PETROLEUM GAS (LPG): Consists of propanes and butanes recovered from natural gas and in petroleum refining. Its energy content ranges between 2000 and 3500 BTU per standard cubic foot. Sometimes called "bottled gas." Used widely as a fuel for internal combustion engines when pollution must be minimized and as a substitute for natural gas in areas not served by pipelines.

LIQUID METAL REACTOR (LMR): A type of nuclear power reactor in which a liquid metal such as sodium flows through the reactor core, is heated, and delivers the heat to produce steam in a separate vessel containing water.

LOAD: The power and energy requirements on the electric power system in a designated area.

MEGAWATT (MW): A unit of power equal to 1000 kilowatts or 1 million watts.

MEGAWATT MONTH: A unit of energy equal to one megawatt of power flowing continuously for an average month of 30.4 days or 730 hours.

NAPTHA: A petroleum fraction with a boiling point ranging from 125 to 240°C. Its principal uses are in solvents, paint thinners, and as a raw material for the production of organic chemicals. It is expected to be used more and more as a raw material for the production of synthetic natural gas.

NATURAL GAS: A gaseous fossil fuel usually found associated with oil. It is made up of about 60% to 80% methane, 5% to 9% ethane, 3% to 18% propane, and 2% to 14% heavier hydrocarbons. Some nonhydrocarbons such as nitrogen, carbon dioxide, and hydrogen sulfide are sometimes present. Propane and the heavier hydrocarbons are usually removed and sold as liquefied petroleum gas. Pipeline natural gas is principally methane and has an energy content of 980 to 1050 BTU per standard cubic foot.

NEUTRON: An electrically neutral particle with slightly more mass than a proton. All atomic nuclei except hydrogen-1 contain neutrons. Because neutrons have no electric charge they can wander freely through matter. Neutrons are not emitted in radioactive decay of atoms, but are emitted in both fission and fusion.

NUCLEAR ENERGY: Atomic energy, released during a nuclear reaction.

NUCLEAR POWER: Electric power produced from a power plant obtaining energy from nuclear reaction.

OIL SHALE: A sedimentary rock which contains an oil-yielding organic material called kerogen. When heated, oil shale may yield as much as 60 gallons of oil per ton of rock.

OUTPUT: The amount of power and energy delivered from a generating station or stations during a specified period.

PETROLEUM: Mineral oil. Fractional distillation yields gasoline, diesel, lubricating oil and other products.

PHOTOSYNTHESIS: The process in which sunlight falling on green plants causes carbon dioxide and water to be converted into more complex organic materials such as glucose.

POWER: The rate at which work is done, therefore, the rate at which energy is transferred. Power is measured in units of work per unit of time. Typical units are the watt and the horsepower.

POWER POOL: A group of electric power suppliers whose transmission lines are interconnected.

PRESSURIZED-WATER REACTOR (PWR): A type of nuclear power reactor in which water circulating through the core is kept under sufficient pressure to prevent boiling of the water. The heated reactor water passes through tubes which are surrounded with a vessel containing water which is allowed to be heated to steam which is then used to drive a turbine.

PROPANE: Inflammable gas obtained from petroleum.

PUMPED HYDROELECTRIC STORAGE: The only means now available for the large-scale storage of electrical energy. Excess electricity produced during periods of low demand is used to pump water up to a reservoir. When demand is high, the water is released to operate a hydroelectric generator. Pumped energy storage returns only about 66% of the electrical energy put into it, but costs less than an equivalent generating capacity.

RADIOACTIVITY: The spontaneous change of atomic nuclei from one nuclear species to another. Such changes are always accompanied by the emission of corpuscular or electromagnetic radiation or both. These emissions are called alpha, beta, and gamma radiations. Alpha radiations are positively charged helium nuclei (2 protons and 2 neutrons) having velocities from 5% to 7% that of light. Beta radiations are negatively and positively charged electrons which may have velocities up to about 99.9% of the speed of light. Gamma radiations are electromagnetic, thus, they are of the same nature as X-rays and light.

RESERVOIR: Water storage lake behind a dam.

RESERVOIR CAPACITY: The usable volume of a reservoir available for the storage and release of water for power generation.

RUN-OFF SEASON: The period of the year when natural flows in streams are supplemented by accelerated snow and ice melt from mountain packs.

SNOWPACK: The winter accumulation of snow in mountain areas which will melt and run off into streams and rivers.

SOLAR CELL: An electric cell which converts radiant energy from the sun into electrical energy.

SPILL: The discharge of water through gates, spillways, or conduits which bypass the hydroplant's turbines.

STEAM ENGINE: A machine which is powered by steam. It can be either turbine or reciprocating.

STREAM FLOW: The rate of water flow past a given point.

SYNTHETIC NATURAL GAS (SNG): A gaseous fuel manufactured from naptha or coal. It contains 95% to 98% methane, and has an energy content of 980 to 1035 BTU per standard cubic foot, about that of natural gas.

STANDARD CUBIC FOOT (SCF): The amount of gas contained in a volume of 1 cubic foot under a pressure of 1 atmosphere (14.73 pounds per square inch) at a temperature of 60°F.

THERMOSTAT: An instrument for the purpose of maintaining a constant temperature.

TRANSMISSION LINES: Wires or cables through which electric power is moved from point to point.

TURBINE: A motor, the shaft of which is rotated by a stream of water, steam, air, or fluid from a nozzle and forced against blades of a wheel.

TURBOGENERATOR: An electric generator powered by steam turbine engine. The steam created by heat from combustible materials (coal, oil, natural gas or other) or from a heat source beneath the earth's surface (geothermal).

TRITIUM: A form of hydrogen atoms whose nuclei contain 1 proton and 2 neutrons. Tritium is radioactive with a half-life of 12.4 years and spontaneously changes to helium-3 with the emission of a negative beta particle. Tritium is expected to be used as a fuel in fusion power plants.

VOLT: Unit of electromotive force moving electrical energy through a conductor.

VOLTAGE: The amount of electromotive force of a quantity of electricity, measured in volts.

VOLTMETER: The instrument for measuring electromotive force. The unit of measurement is volts.

WATT (W): A unit of measure for electric power equal to the transfer of 1 joule of energy per second. The watt is the unit of power most often associated with electricity.
(1 horsepower = 746 watts) Determined by multiplying required volts by required amperes (volts x amps).

WATT HOUR: Work done at the rate of 1 watt for 1 hour.

WORK: Work is done whenever a force is exerted through a distance. The amount of work done is the product of force and distance. The metric unit of work is the joule (J.) When a force of 1 neutron is exerted through a distance of 1 meter 1 joule of work is done.

POWER PLANT TOURS AND INFORMATION

Wells Hydroelectric Combine Douglas County P.U.D. 1151 N. Main Street East Wenatchee, WA 98801	Phone
Information Officer - Stan Pennington	509-884-7191
Rocky Reach Hydroelectric Project Chelan County P.U.D. #1 Box 1231 Wenatchee, WA 98801	
Administrative Secretary - Shirley Byquist	509-663-8121
Wanapum & Priest Rapids Project Grant County P.U.D. Box 878 Ephrata, WA 98823	
Officer Supervisor - Boyd Erikson	509-754-3541, Ext. 8233
Trojan Nuclear Plant Trojan Nuclear Visitors Information Center Route 2, Box 120 Rainier, Oregon 97048	503-556-4741
Centralia Steam Electric Plant Pacific Power & Light Co. 920 S.W. Sixth Avenue Portland, Oregon	(Information only - no tours) Attention: Robert Peterson
Centralia Coal Mine - Washington Water Power Co. Washington Irrigation & Development Route 2, Box 42 Centralia, WA 98531	(Tours)
Manager - R. W. Beadnell	206-736-2831
Snoqualmie Falls & Eastside Tours Puget Sound Power Building Bellevue, WA 98009	
Contact Persons: Jack Schwartz; W. J. Finnegan	206-454-6363, Ext. 336 or 385
Nuclear Information Center 201 Township Road Sedro Woolley, WA 98284	
Attention: Debbie Spellman; Vickie Henderson	206-454-6363, Ext. 601 206-856-9111

Energy Alert Contract

I _____ do solemnly promise to do the following things to help relieve the world-wide energy problem:

1

2

3

Signed _____

Witnessed by _____

CREDITS

A special note of recognition is in order for the fine personal support and cooperation extended the Energy Awareness Week staff just about everywhere.

In addition, several documents were used extensively as references, and provided much of the inspiration necessary for this program. We would be remiss if the influence of these special people and resources were not recognized.

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American Geological Institute for activity ideas from the Environmental Studies Cards.

More activity ideas from the Materials and Technology Curriculum Project of the University of Washington, Seattle.

Three fuels--wood, coal and petroleum--provide almost all the energy used by modern man.

The heat energy released as each of these fuels burns is similar in form, but it is more concentrated in one than in another. A pound of wood, for instance, in burning releases about 1500 kilocalories of heat; a pound of coal provides about 3200, while a pound of petroleum produces approximately 5000 kilocalories. By comparison, a man engaged in physical labor requires 3000 kilocalories of energy each day.

FRIDAY—A TRUTH SESSION

A TRUTH SESSION

DISTRICT _____ CLASS OR GRADE _____

SCHOOL _____

As a result of energy awareness week activities:

1. The students in my class/school are behaving differently now in the following ways: _____
   _____
   _____

2. Make a list of student learnings during Energy Awareness Week. This might be done in small groups of four or five or as a class. _____
   _____
   _____

3. How could we have helped you make the week more effective? (What didn't you learn that you would like to know?) _____
   _____
   _____

4. What kinds of technical assistance could the program use:

   ☐ Printed materials, such as _____
   ☐ Consultant help on _____
   ☐ Training workshops in _____
   ☐ Other (please specify) _____
   _____
   _____

When you complete this form, tear out, fold, staple, stamp, and send to the address on the other side.

Thank you.

Dave Kennedy
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Olympia, WA. 98504